MECHANICAL ENGINEERING

May 1956

in this issue

Practical Considerations in Designing Railway Passenger Cars . . . . . A. G. Dean 410

Electronic Computers Solving Production-Engineering Problems . . . . . C. R. De Carlo 416

Relating Materials-Handling Costs to Over-All Production Costs . . . . . B. W. Saunders 419

Application of Superheated-Vapor Atmospheres to Drying . . . A. M. Lane and Stuart Stern 423

The Engineer Looks at Management Positions . . . . . R. P. Kroon 427

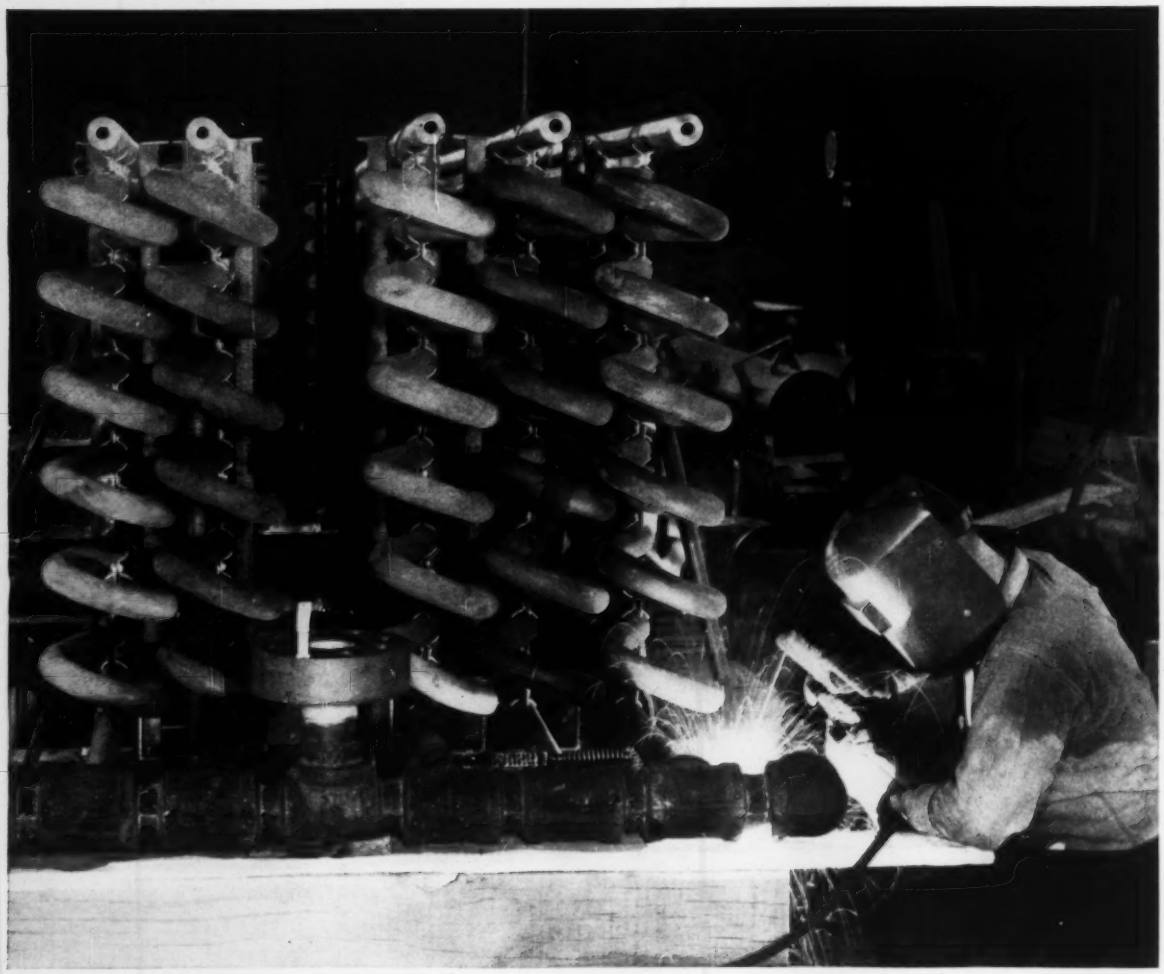
Utilities Systems for a 30,000-Barrel-Per-Day Refinery . . . . . C. E. Peterson 430

The Shortage Re-Examined . . . . . J. R. Killian, Jr. 433

DEPARTMENTS

Editorial 409
Briefing the Record . . . 440
European Survey 456
ASME Technical Digest . . 458
Comments on Papers . . . 466
Reviews of Books 469
ASME Boiler and Pressure Vessel Code . 471
ASME News 472
Keep Informed . . . Adv. p. 41

ASME Semi-Annual Meeting • Cleveland, Ohio • June 17-21, 1956



Putting the Chill on NH_3

The Vilter Manufacturing Co. of Milwaukee, Wis., makes, among other interesting and useful products, ammonia (NH_3) synthesis coolers. These coolers must contain the newly-made hot gas at a pressure of 10,000 psi and reduce its temperature by means of cooling water conducted over the tubes.

To meet its exacting requirements, Vilter chose B&W Seamless Tubing, made for high-pressure service. All tubing in these coolers is tested at 15,000 psi.

To bend these heavy-wall tubes to a 4″ radius, 3⅛″ off the vertical plane, is evidence of Vilter's skill and craftsmanship at work.

And for evidence of how B&W tubing can help improve your own skill and craftsmanship, get in touch with Mr. Tubes, or write for Bulletin 408. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

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FACTS

about

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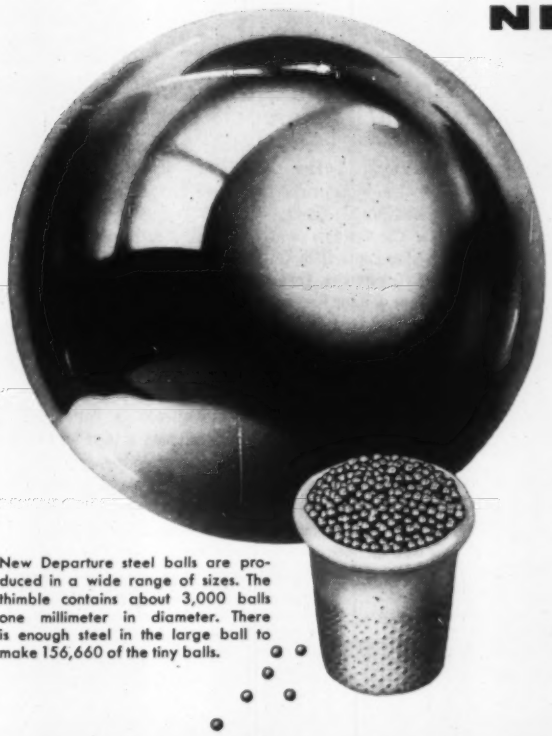


New Departure steel balls are produced in a wide range of sizes. The thimble contains about 3,000 balls one millimeter in diameter. There is enough steel in the large ball to make 156,660 of the tiny balls.

Available in any quantity to fit your specifications for grade, size and accuracy!

When industry wants steel balls of proven accuracy and dependability, it is only natural that they turn to New Departure, leading producer of ball bearings and therefore thoroughly experienced in the manufacture of precision balls. Today, New Departure provides industry with high-carbon chrome and stainless steel balls in a wide range of sizes and specifications.

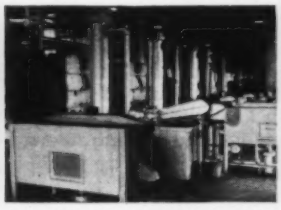
New Departure balls are produced from the finest high-carbon chrome steel. AISI Type E51100 steel, specially made for New Departure, is heat-treated to achieve the proper hardness and toughness for maximum strength and life in the finished product. Stainless steel, AISI Type 440C, used by New Departure results in balls of much improved hardness and load-carrying ability.

In addition to producing the finest steel balls available, New Departure will fill volume orders for balls of special materials such as high-nickel or cobalt-base alloys, tool steel and others.

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.

Steel ball wire is drawn through dies to assure uniform diameter and roundness.

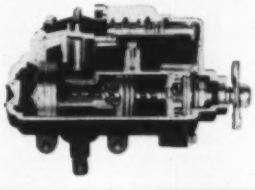
Precise control of grain flow is obtained with these Ball Heading Machines.



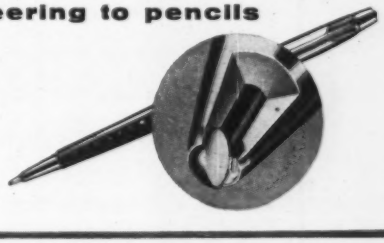
Balls are heat-treated, quenched in oil or water, then tempered in electric furnaces.

These gauges sort balls into lots according to required diameter limits.

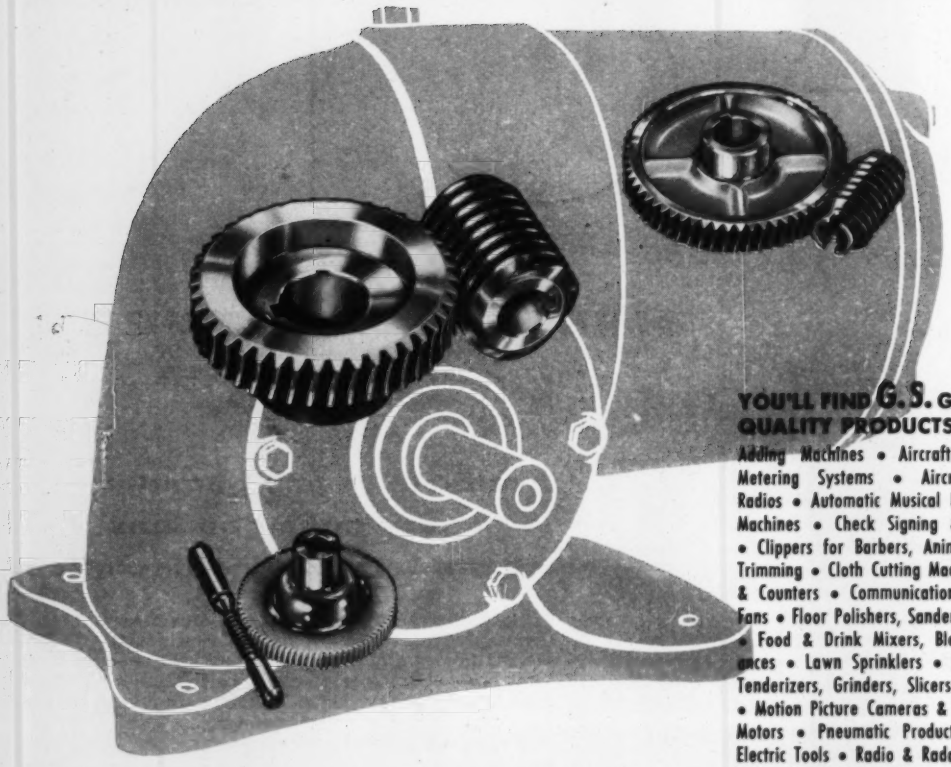
Applications range from power steering to pencils



The unique advantages of New Departure steel balls are utilized in many applications ranging from heavy-duty bearings to the new liquid lead pencil. To accommodate these applications, New Departure steel balls are offered in sizes ranging from .025 inch to 1⅞ inches in diameter.



MECHANICAL ENGINEERING, May, 1956, Vol. 78, No. 5. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢; to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.



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take a good look at the Walworth "500 Brinell" no. 225P Globe

NEWLY DESIGNED HANDWHEEL: Patented air-cooled, finger-fit handwheel affords sure grip even with greasy gloves.

– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular.

IMPROVED PACKING: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure when fully opened.

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SEATS AND DISCS: Plug type seats and discs of stainless steel, heat-treated to 500 Brinell hardness and machined simultaneously to a mirror-like finish, with accurate tapers assures tight positive shut-off with minimum handwheel effort.

EXTRA STRONG BODY: Made of Composition M (ASTM B61) bronze. Thick walls and rugged hexes provide a high safety factor. Valves undergo hydrostatic shell test of 1,200 psi.

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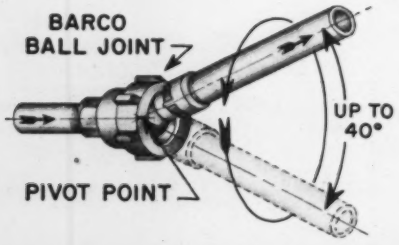
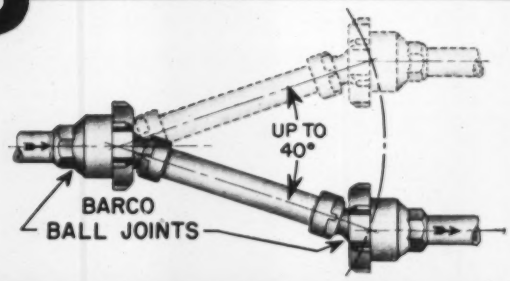
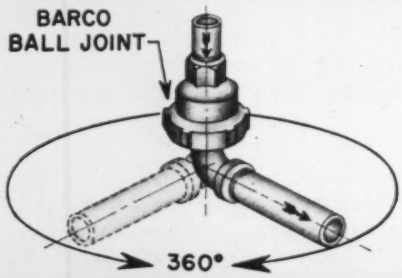


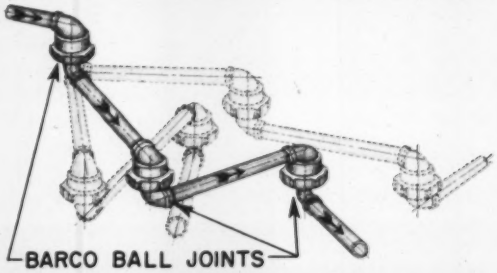
ONE JOINT—Provides for angular motion or positioning of piping in any plane. (Also see below.)



TWO JOINTS—This arrangement provides for piping alignment or simple flexible connection.



ONE JOINT—Allows for full 360 swivel or swing motion, in addition to angular movement shown above.



THREE (OR MORE) JOINTS—For complete flexibility. Any angle! Any radius! Any plane! Many arrangements possible.

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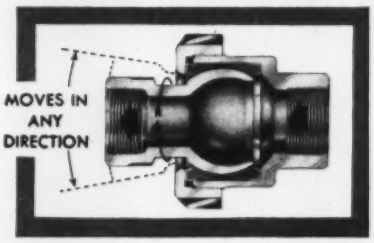
THE four basic principles of motion illustrated above make the BARCO Flexible Ball Joint one of the most useful, most versatile fittings ever developed for application to piping conveying steam, water, air, chemicals, oil, and countless other fluids. *One joint often does the work of two or more ordinary swivel joints, because it moves in any direction!*

Metal pipe made flexible with Barco Flexible Ball Joints is practically indestructible. Long range planning calls for the permanence of this type of construction—*for freedom from maintenance and replacement, and SAFETY!*

There are many applications for Barco Flexible Ball Joints in industry: (1) To permit movement, (2) To accommodate expansion and contraction, (3) To provide for alignment, (4) To insulate against vibration and shock. For piping up to 12". Wide choice of styles and materials. *Let us give you the complete story.*

GET THE FACTS—New Catalog 215B is an interesting, illustrated handbook on the application of Barco Flexible Ball Joints. Send for your copy NOW.



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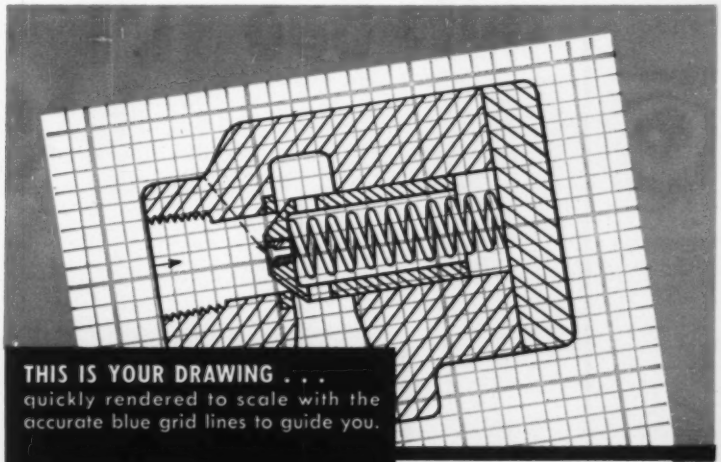

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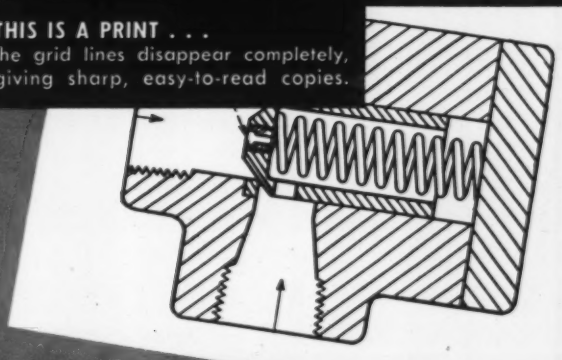

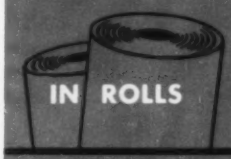

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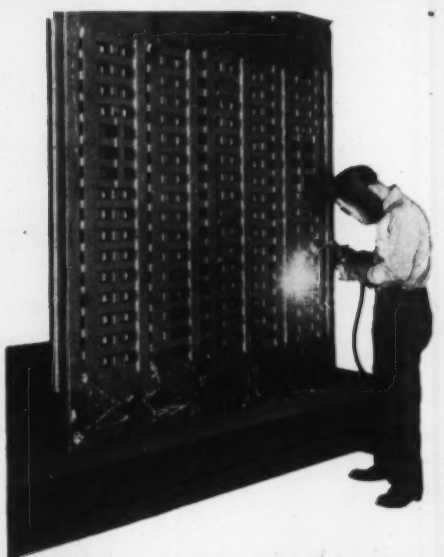
HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS...

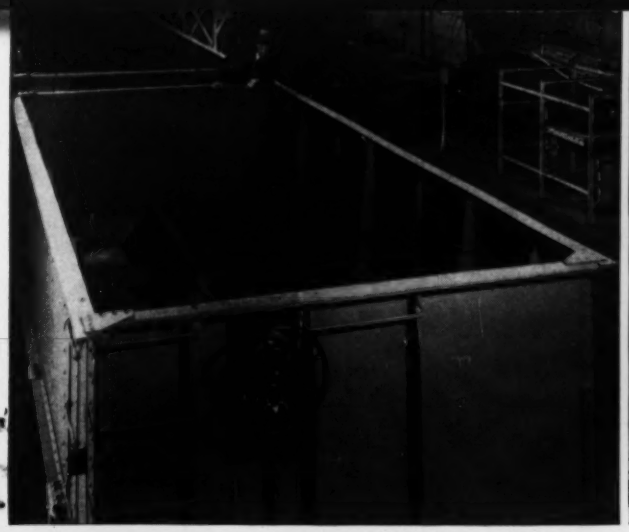
. . . Lops off 1,047 Pounds

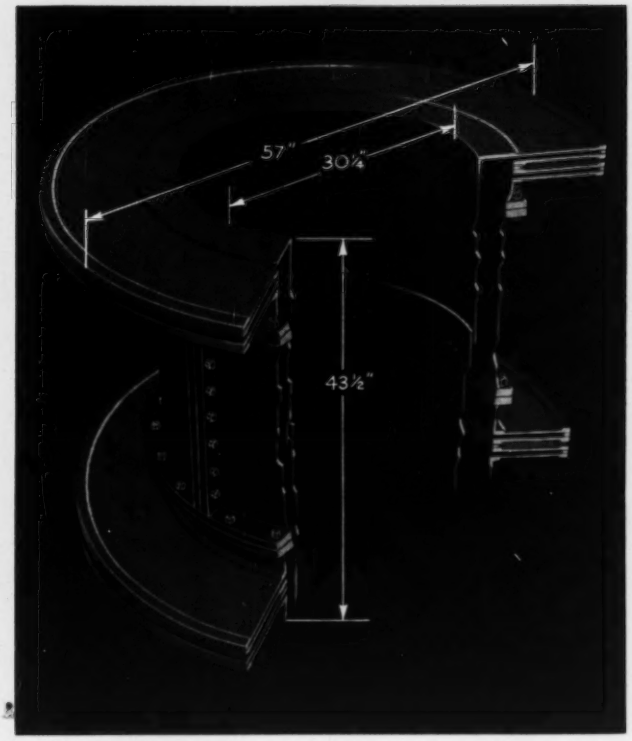
Trays for ore clean-up buckets need tremendous resistance to impact, abuse and abrasion. Blaw-Knox Company, Pittsburgh, Pa., found that they weigh half a ton less, and cost less to fabricate when made from USS "T-1" Steel plate instead of heavy steel castings.

. . . 534 Easier Welds

This printing press bedplate, manufactured by Graver Tank & Manufacturing Co., Inc., must be welded in 534 places. High alloy steel with the needed strength was very difficult to weld. But USS "T-1" Steel is easy to weld . . . and has the needed strength to keep these bedplates, used on high-speed printing presses, as lightweight as possible.







. . . Saves $18,043

In structures like this, which are steel bellows that flex up-and-down and sideways, large thermal expansions can be accommodated. These expansion bellows surround struts which support a large axial flow compressor rotor. The bellows are connected from the compressor stator to the foundation. Westinghouse Electric Corporation switched to USS "T-1" Steel . . . promptly cut not only the cost of machining and welding, but also cost of the steel itself—saved $18,043.

. . . Three Ways Better

International Nickel Company of Canada expects USS "T-1" Steel to increase the service life, to reduce the maintenance, and lower the long-term cost of ore cars like this one; because "T-1" Steel has far greater strength, toughness, and resistance to abrasion than steel used previously. The car builder, Canadian Car and Foundry Co., Ltd., has had no difficulty fabricating this very strong alloy steel.

HOW USS "T-1" STEEL CAN HELP YOU

The great strength and toughness of USS "T-1" Steel (90,000 psi. minimum yield strength) helps you to increase the capacity and durability of power shovel buckets and storage tanks without increasing weight.

Its excellent weldability enables you to fabricate large equipment out in the field without heat treatment . . . thus, reduces fabricating and shipping costs and speeds up construction.

Its unusual toughness at sub-zero temperatures helps you to lengthen service life of equipment that must take impact, abrasion, and abuse in all weather.

USS "T-1" Steel also gives you good creep rupture strength to 900° F. It often can be substituted for more expensive steels that are more difficult to fabricate. There is a place for "T-1" Steel somewhere in your designs. Write, wire, or phone for more information. United States Steel, Room 5291, Pittsburgh 30, Pa.

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USS "T-1" CONSTRUCTIONAL ALLOY STEEL

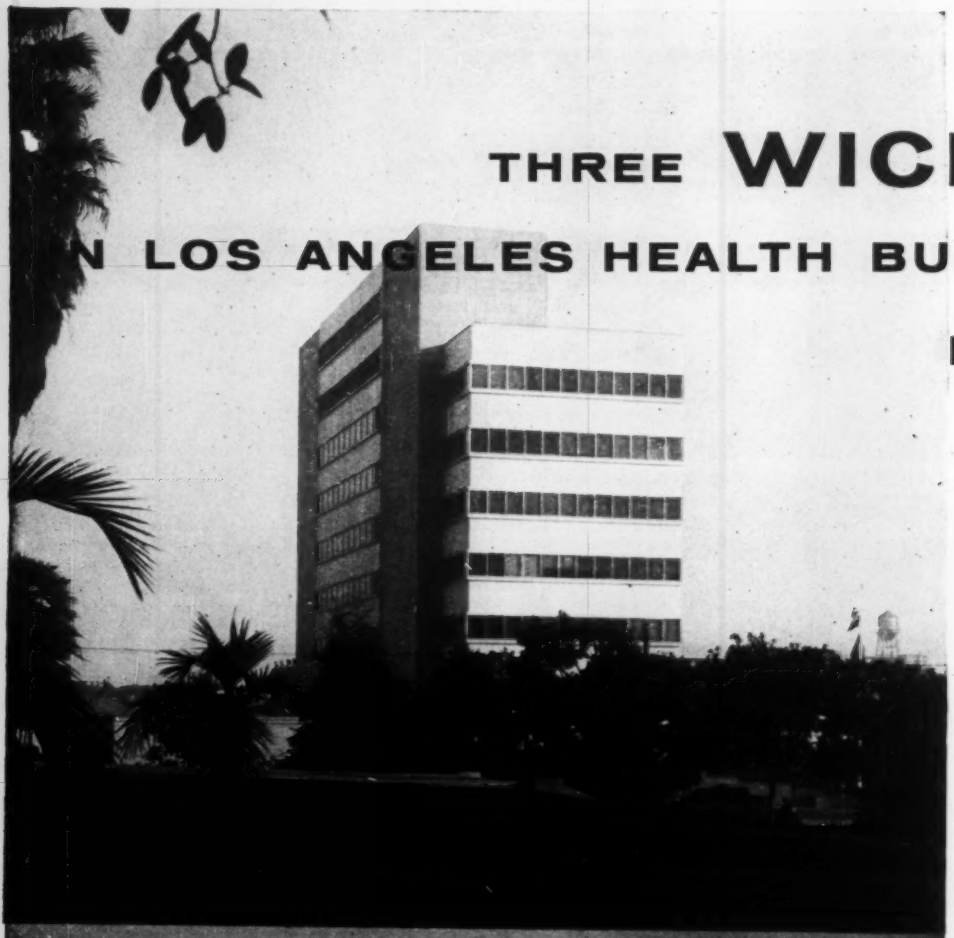
USS

UNITED STATES STEEL

THREE WICKES

N LOS ANGELES HEALTH BUILDING

IS THE



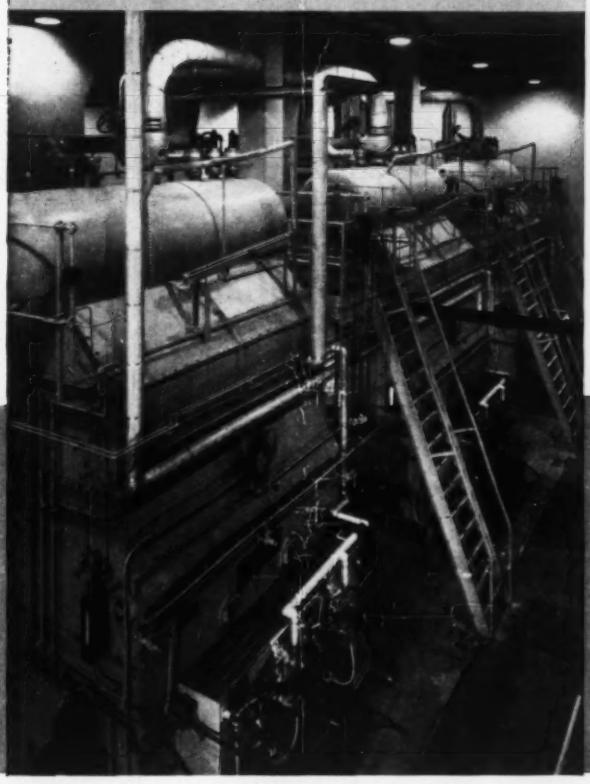
Architects: Lunden, Hayward, and O'Connor
Builder: Robert E. McKee General Contractor, Inc.

Housed in the striking modern structure shown here is a new clinic and health center for the city of Los Angeles Health Department. Beautifully equipped in every respect, the building has individual room thermostats to insure the exact desired temperature in each separate area . . . clinics, laboratories, medical sections, and others. To insure that the heating system responds immediately to these controls, the builders installed three dependable Wickes water tube steam generators. In addition to supplying the big nine-story Health Center with heat, the Wickes boilers also serve the entire City Hall building nearby, and the new Police Facilities building (a feature of this integrated Civic Center layout is that these buildings are connected to the Health Center by pedestrian tunnels, which are likewise heated by the Wickes boiler installation). Pictured at right is one of the modern health laboratories.

WICKES

STEAM GENERATORS WHERE DEPENDABILITY MOST VITAL FACTOR

The three Wickes boilers shown below supply heat for not only the Health Center but also the City Hall and new Police building.

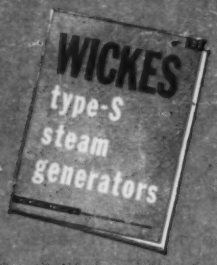


These 2-drum type-S Wickes steam generators are compact and efficient water tube units. Built to a design pressure of 160 psi, and with 3400 square feet of heating surface, each of these Wickes units is fired by 2 Multijet Combination gas and oil burners. They are quickly responsive to extreme fluctuations in load, and the large steam drums make certain of ample steaming capacity with dry steam. Wickes 2-drum type-S steam generators are readily adaptable to completely automatic control.

Other Wickes 2-drum, type-S, modern steam generators are available in the Series S1A and S2A. These units combine the water cooled furnace as an integral part of the boiler, adapting the high and low type furnace to the desired method of firing . . . coal, oil or gas. They are built to the design pressure of 725 psi; superheaters and recovery equipment are available.

WRITE FOR OUR NEW BROCHURE

Our new Catalog 55-2 contains complete information on Wickes 2-drum type-S steam generators. A general description is given of these modern efficient boilers, together with four insert pages of engineering drawings and data. We will also send you our complete facilities Bulletin No. 55-1.



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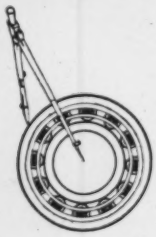
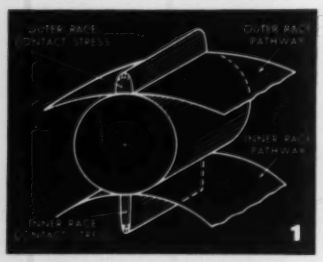
Cylindrical Roller Bearing Outer Races



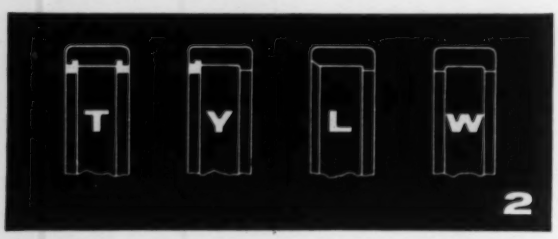
Why they are necessary . . . their importance in relation to bearing versatility . . . wide variety of configurations and locating devices

Outer races are necessary parts of all roller bearings, except in cases where a roller operating surface of suitable hardness and finish can be provided in the housing. In housings of aluminum, cast iron or unheat-treated steel where a hardened and ground surface cannot be obtained by any practical means, outer races are required to assure a fatigue-resistant pathway on which the rollers can operate smoothly.



The outer race is not normally the critical member of a cylindrical roller bearing. This does not mean, however, that outer races cannot suffer fatigue failure. All objects subjected to stress repetitions can fail after a small number of stresses—or may enjoy a surprisingly long life. But experience definitely shows that percentages favor the outer race, and the reason is apparent in Figure 1, which shows a roller engaging both an outer and inner race. Note that the load is spread over a larger area of contact on the outer race, which results in a much smaller maximum stress. This demonstrates in part the principal reason why inner races are the critical member of most cylindrical roller bearings, as explained in one of our previous messages.

Nevertheless, HYATT outer races are manufactured with the same scrupulous care that is applied to inner races and all other components of HYATT Bearings. Outer race performance must match the performance of the rest of the bearing. We consider the fact that the outer race is not the critical member as a safety factor—*not a license to reduce quality.*



1. OUTER RACE TYPES

HYATT Hy-Load outer races are available in a variety of standard configurations for every type of application requirement (Figure 2). The W, L and Y races have solid flanges capable of sustaining light or intermittent thrust loads. The T and Y races are assembled with internal snap rings; they have equal radial load-carrying capacity but are not recommended for applications where a continuous thrust would be taken by the snap rings. The T, Y, L and W races may all be mounted using the roller ends against either the solid shoulder or internal snap ring for purposes of locating the outer race axially.

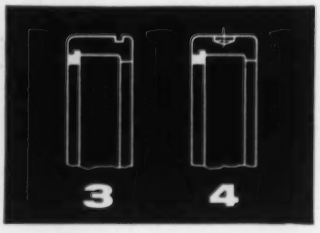
2. CIRCUMFERENTIAL LOCATION

An ample choice of outer race locating methods may be used with HYATT Hy-Loads. Circumferential location is often accomplished by the use of a press fit. (Our general recommendation is that the *rotating* race be applied with a press fit and the *stationary* race be applied with a push fit.) When a push fit is employed, circumferential location is satisfactorily accomplished by axial clamping against the race ends. *Positive* circumferential location is provided by the use of an outer race dowel.

3. AXIAL LOCATION

Axial location of an outer race is conventionally accomplished by pressing or pushing the race to a housing shoulder. The race may be constrained from "walking out" of the housing bore by the flange or snap ring operating against the roller ends. *Positive* axial location is accomplished by axial clamping against a housing shoulder or snap ring.

It may occur, however, that a shoulder is not available in the housing. Under these circumstances, it is necessary to employ an auxiliary holding device such as an external snap ring or an outer race dowel. HYATT Hy-Load Bearings can be supplied to original equipment builders with outer races having a snap ring groove (Figure 3) or a blind dowel hole (Figure 4) at small added cost.



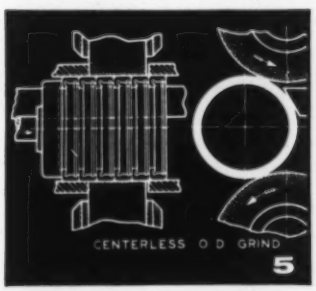
Grinding the flange on a Hyatt outer race.

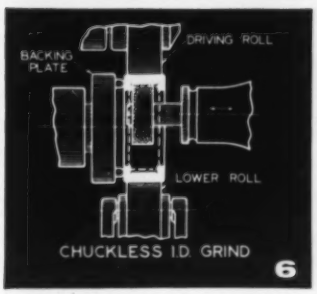
4. OPERATIONAL REQUIREMENTS

Since the outer race is usually the stationary member of the bearing, the exact maintenance of wall variations and runout is not ordinarily critical. However, the outer race *may* be the rotating race in certain applications—so quality controls are rigidly applied to all HYATT outer races to maintain:

a. Minimum wall variation. **b.** Minimum runout of race ends to bore. **c.** Minimum runout of race flange inner faces to bore. **d.** Minimum pathway and outer diameter taper. **e.** Minimum outer diameter tolerance.

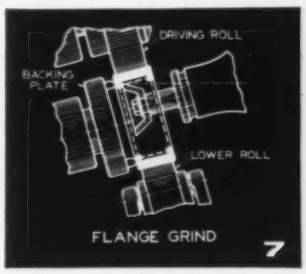
5. MANUFACTURING PROCEDURES





During manufacture, the following sequence of operations provide the controls necessary to generate outer races which meet the strict operational standards maintained by HYATT: After careful primary machining and heat treating, the ends are faced off square and parallel by a double end grind. This provides a reference surface from which all runouts and squareness can be gaged. Outer race diameters are generated by the centerless grinding method to provide an O.D. with as little out-of-round as practical. The through-feed method of grinding represents a valuable economy (Figure 5) to help reduce race costs.

Next, the pathway (or race I.D.) is ground centerless, generating a cylinder concentric with the O.D. cylinder. This is accomplished by driving the race on the O.D. and positioning the grinding wheel relative to the drive roll (Figure 6). Finally, the flanges are ground using the race ends as a reference. The result is a race of as nearly perfect geometry as is practical (Figure 7). It is then critically inspected to insure traditional HYATT dependability and the maximum possible service life.



YOU WILL FIND FURTHER DETAILS in HYATT General Catalog No. 150, or your nearby HYATT Sales Engineer will gladly help you choose the type of cylindrical roller bearings best suited to your design requirements. Remember, HYATT is America's *first* and *foremost* maker of roller bearings. Hyatt Bearings Division of General Motors, Harrison, N. J.

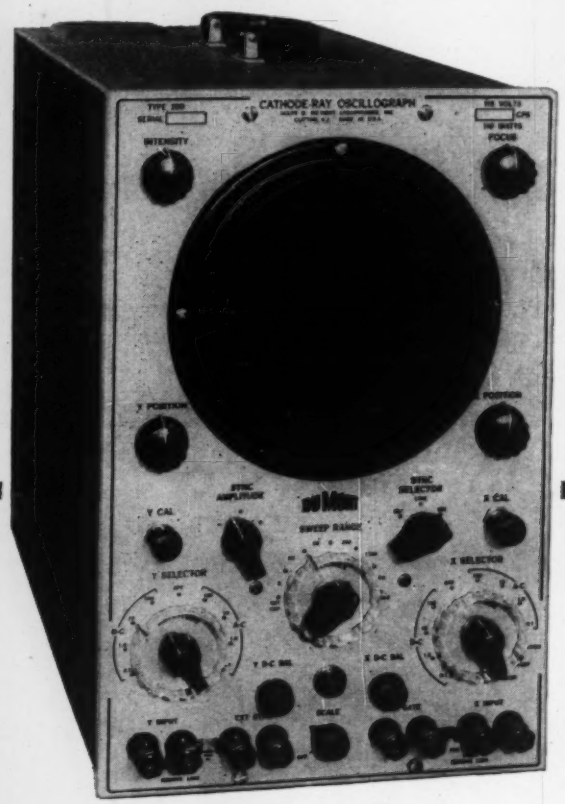
GM GENERAL MOTORS

HYATT

ROLLER BEARINGS

THE *New* CHAMPION

350



Not just another low-frequency cathode-ray oscillograph but a decidedly grown up instrument combining the best features of the laboratory standards by Du Mont which have gone before it. All these features and more:

- **Exceptional stability—all voltages regulated**
- **No drift—less than 10 mv in 8 hrs. including 10% line voltage changes**
- **Identical X- and Y-amplifiers**
- **Amplitude calibration on both axes**
- **Accurate X-Y plotting at frequencies from d.c. to 150 kc.**
- **Ideal for precise phase shift measurements—less than 1° relative phase shift below 150 kc.**
- **Superior sweep linearity with hard-tube circuit**
- **Automatic beam brightening on sweeps**
- **Automatic beam brightening for transient plots**
- **High brightness—3KV acceleration**
- **Provision for very slow sweep rates**

CONDENSED SPECIFICATIONS:

VERTICAL DEFLECTION: *sinusoidal response,* flat to d.c., down not more than 30% at 150 kc; *deflection factor,* 20 p-p mv/inch.

HORIZONTAL DEFLECTION: identical to vertical axis except *deflection factor,* 25 p-p mv/inch (due to higher deflection factor of horizontal deflection plates).

SWEEPS: *mode,* driven or recurrent; *frequency,* 2 cps to 30 kc; *beam gate,* automatic during forward sweep.

AMPLITUDE MEASUREMENT: (both X and Y axes) *range,* 0.1, 1, 10 and 100 volts full scale; accuracy, ±5%.

PHASE SHIFT: *amplitude controls at max.,* less than 1° below 150 kc.

PRICE ONLY **$395**

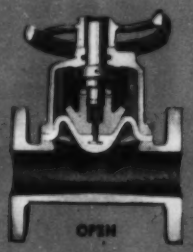
IMMEDIATE DELIVERY!

Write for complete specifications

DU MONT ALLEN B. DU MONT LABORATORIES, INC., 750

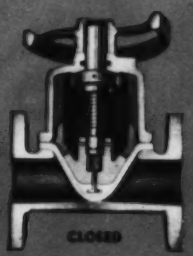
Flow Characteristics
similar to gate valves

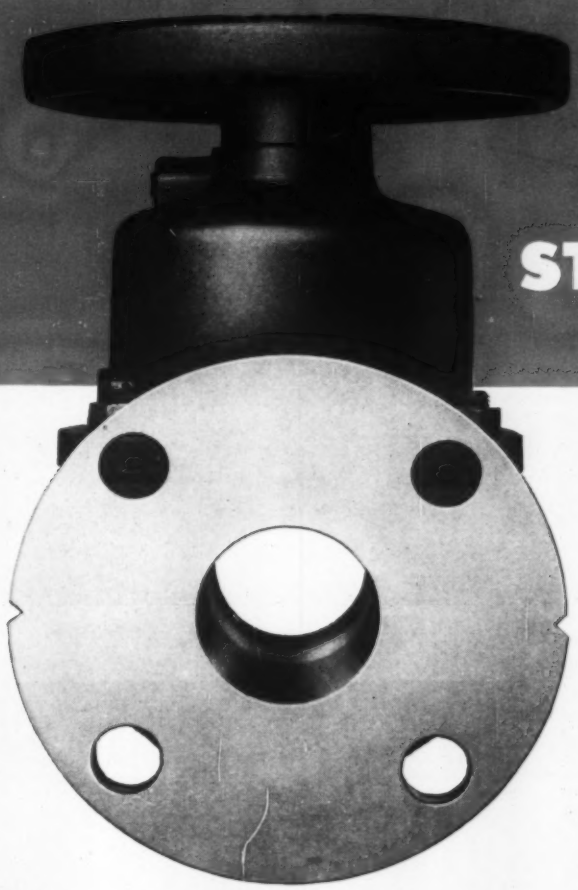
- Streamlined straight-through flow
- Minimum pressure drop
- Handles viscous materials without stoppage
- May be rodded or brushed



Advantages
of a diaphragm valve

- Positive closure even with gritty or fibrous materials
- No pockets to trap sludge
- Bonnet mechanism completely isolated from fluid in line
- Completely self-draining
- Simple maintenance





GRINNELL-SAUNDERS STRAIGHTWAY DIAPHRAGM VALVE

For handling viscous materials, slurries, sludges, solids in suspension, sewage and corrosive chemicals, Grinnell now offers a valve which has all the advantages of a diaphragm valve with the added benefits of straight-through flow.

The Straightway Diaphragm Valve* is made in sizes from ½" to 8", screwed or flanged ends, either hand wheel or power operated.

A variety of body, lining and diaphragm materials are available to meet practically all requirements. Descriptive folder gives all details.

*Patented

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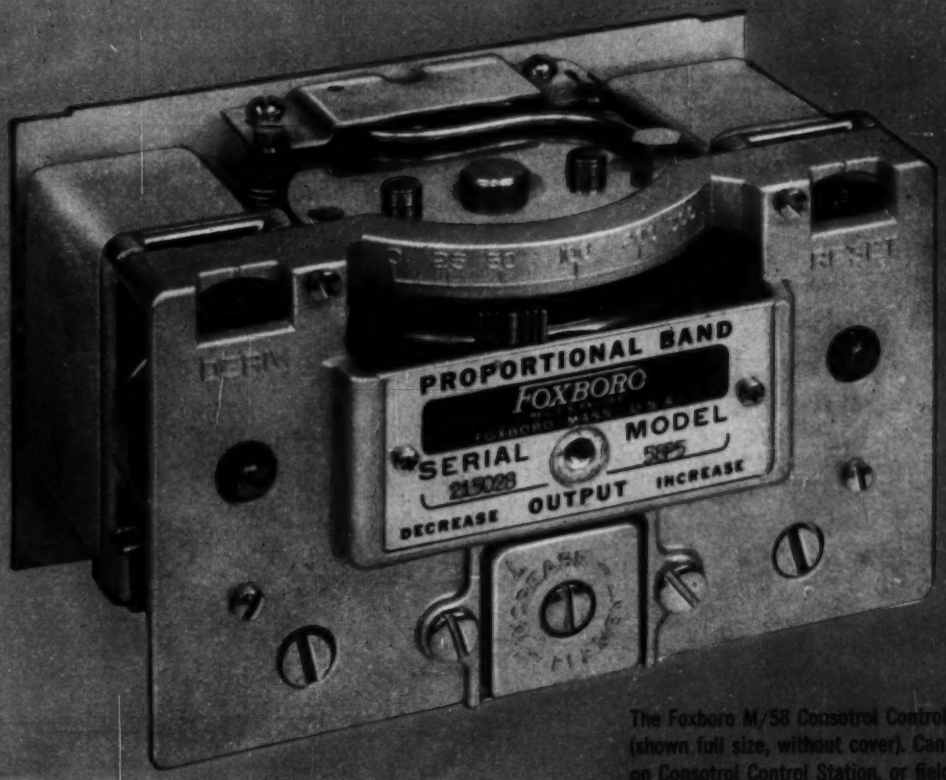


The Foxboro M/58 Consotrol Controller (shown full size, without cover). Can be panel-mounted on Consotrol Control Station, or field-mounted.

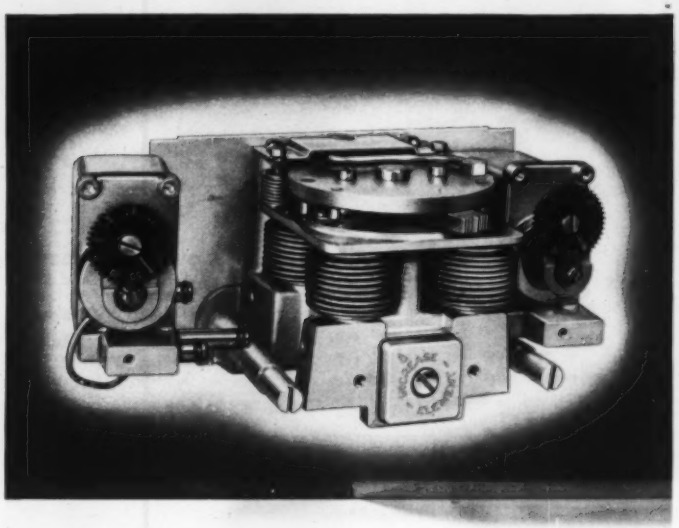
THE FOXBORO M/58 CONSOTROL

The M/58 Controller's Revolutionary Floating Disc System

Here's the exclusive Foxboro design development that gives M/58 Control its unique versatility, precision, and stability. The floating disc and matched bellows assure uniformly high controller sensitivity and pin-point control action, even at widest settings of the proportional band. Lever-set proportional band adjustment is calibrated to 500%.

Component Construction Gives Unrivaled Versatility

Not only is the complete controller easily detachable as a unit, but also, each component is a "plug-in" unit. For example, reset plugs in at right as shown; derivative, similarly, at left. All 4 control actions, with 2 reset ranges, are available and easily adjustable to widest variations in operating conditions. Proportional action from 1 to 500% quickly set by lever.



Outperforms all other controllers!

...the controller with the FLOATING DISC

If you think this claim is exaggerated, just put a Foxboro M/58 Consotrol* Controller on your process. The tougher the job, the more it will outperform other controllers! Or ask any present user . . . many of the largest, most progressive petroleum and chemical processors are using hundreds of these instruments. They will unhesitatingly confirm that this exclusive Foxoboro development has put their processes "on stream", automatically and smoothly from the control room, without false starts or confusion.

The M/58 Controller can do the same for your process. The flexibility of its control functions makes it readily adaptable to *all* processing techniques. All four actions are available, with two ranges of reset . . . all are easily adjustable to the most widely varying operating conditions. For example, reset and derivative functions plug in . . . proportional action from 1 to 500% can be quickly set by a lever. And calibration is a simple zero adjustment!

Get full details on this simple, truly "universal" Controller. Write for Bulletin 13-19 and ask your Foxboro Sales Engineer for a demonstration. The Foxboro Company, 965 Neponset Ave., Foxboro, Mass., U.S.A.

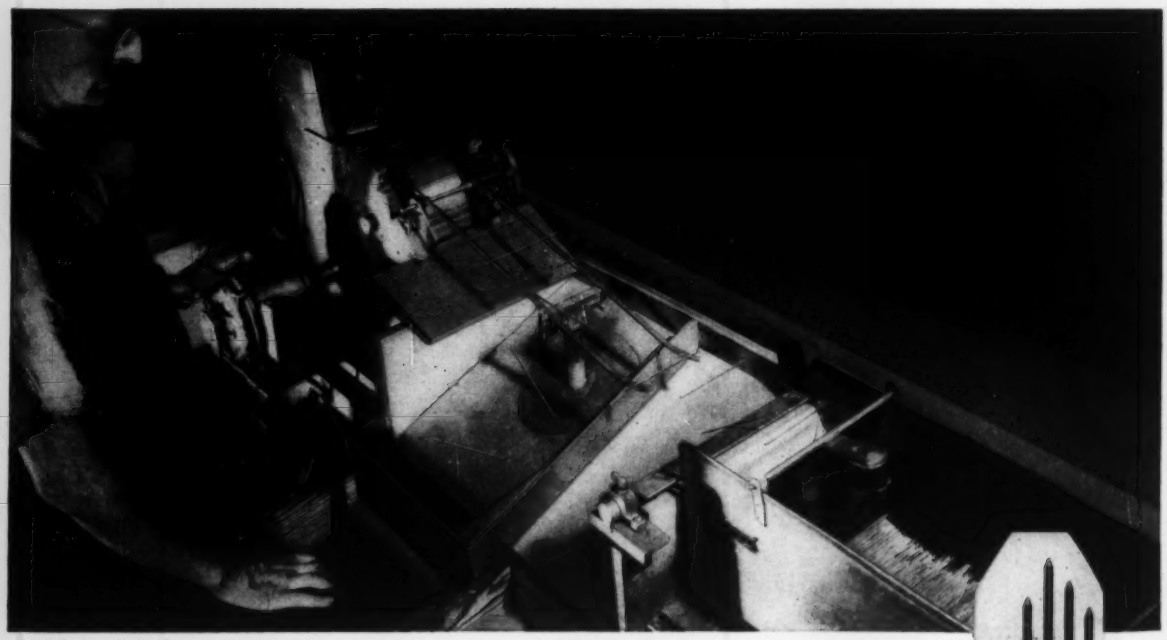
*Reg. U.S. Pat. Off.

FOXBORO CONSOTROL INSTRUMENTS

Reg. U.S. Pat. Off.

We put Turquoise leads over the jumps

SO THEY WON'T BIND IN YOUR HOLDER!



To assure you of perfectly straight, symmetrical Turquoise Drawing Leads, we send them down this "ski jump" in the Eagle Pencil plant.

The slightest unevenness in a lead makes it wobble and careen off the end of the jump into the "reject chamber". Only the true, perfectly formed leads clear the gap, and land in your holder.

Turquoise leads are of "*Electronic" graphite – reduced to micronic size. Millions more of these finer graphite particles are compacted in every inch of lead. That's why Turquoise deposits a denser, blacker line that reproduces to perfection . . . gives you the strongest, smoothest, longest-wearing point that ever met paper. 17 degrees, 6B to 9H.

*TURQUOISE

DRAWING PENCILS, LEADS AND HOLDERS

HEADQUARTERS FOR QUALITY PENCILS · 100 YEARS · EAGLE PENCIL COMPANY · 1856-1956

NEW LEAD HOLDER! Eagle's *new* 3379 Turquoise Lead Holder is precision-made for trouble-free operation. The *Prestomatic* button releases the lead—and a spring relocks the rifled jaws to hold the lead firmly in place. Red, yellow, and green release buttons identify the degree of lead contained.

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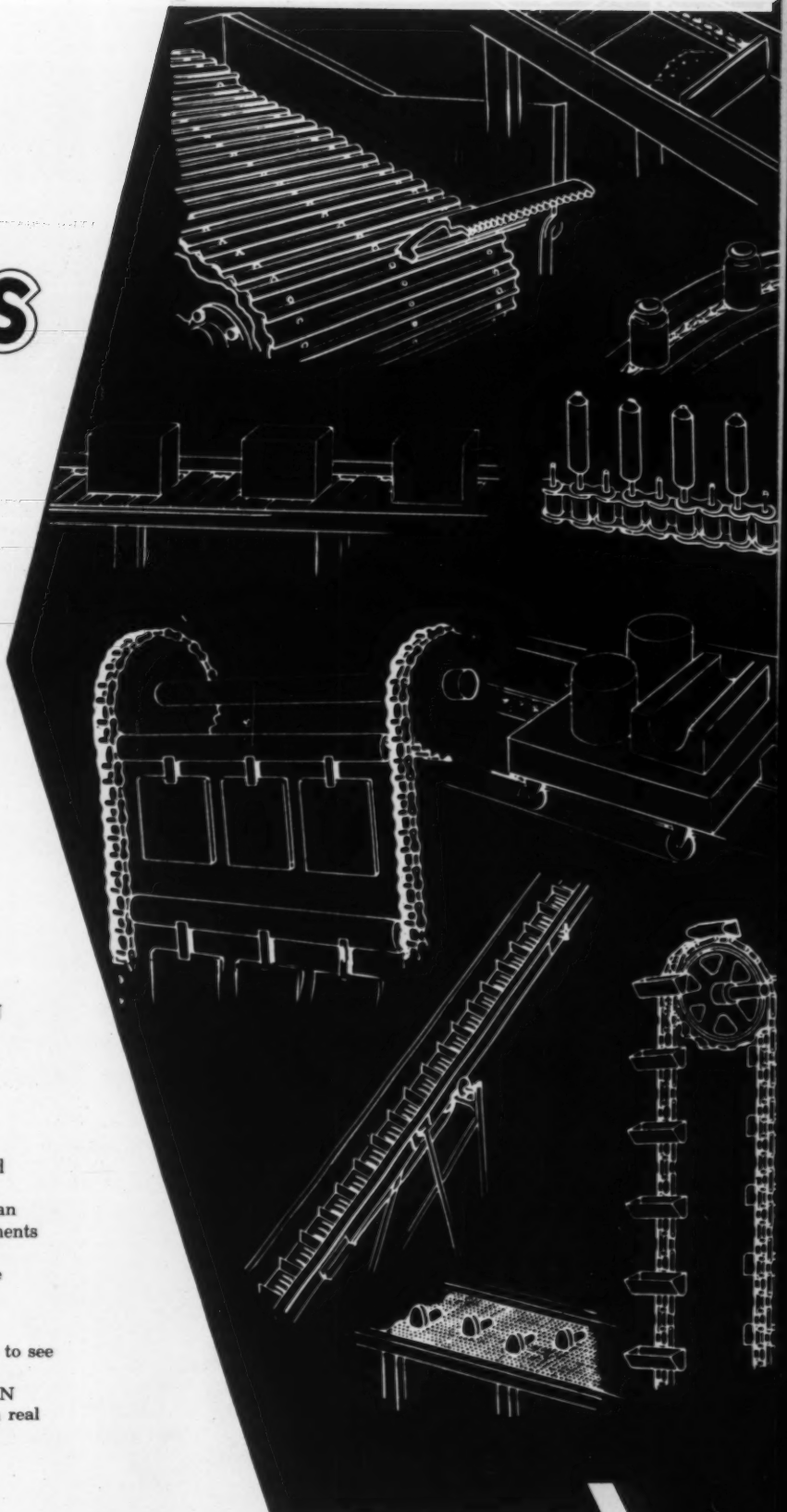
Idea Sparkers

for

MATERIAL HANDLING



Ever been caught "dead center" on design . . . just needing a "spark" to trigger the idea you need to get going again?
Perhaps there's an idea here for you . . . a different use of chains and attachments that might help you find a better, more efficient way to move materials.

For example, in the complete CHAIN Belt line, there are dozens of different types of chain attachments that can be used in hundreds of different ways.
Bars, rods, slats, plates, tripping mechanisms, pins, tabs and many other devices can be simply fastened to chain attachments to perform a multitude of tasks. Many chains can operate as conveyors without attachments . . . using their surfaces as a carrier. There are virtually no limits to the things you can do with efficient chain and attachments.

We'll be happy to work with you . . . to see if we can come up with an idea that can solve your problems. Your CHAIN Belt District Sales Engineer can be a real help to you, backed by our conveyor chain engineers.

TURN THIS PAGE FOR MORE INFORMATION

CHAIN BELT COMPANY

LEADERSHIP . . . through creative engineering

IDEA SPARKERS *(CONTINUED)*

Why not send for informative literature on conveyor chains and attachments? You'll be amazed at ideas you'll get just from looking over the many attachments you probably never dreamed existed. Just mail the coupon below. There is no obligation.

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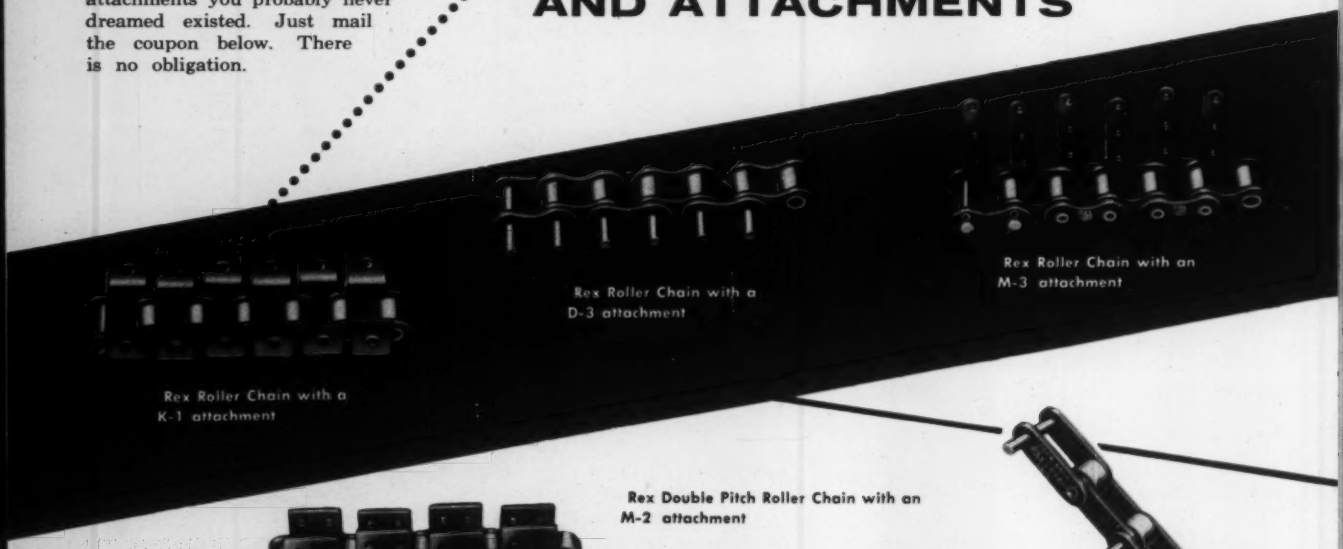
CONVEYOR CHAINS AND ATTACHMENTS

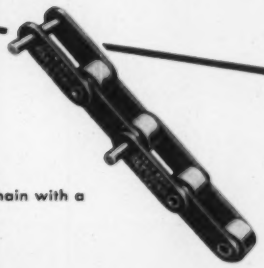


Rex Roller Chain with a K-1 attachment

Rex Roller Chain with a D-3 attachment

Rex Roller Chain with an M-3 attachment

Rex Double Pitch Roller Chain with an M-2 attachment



Rex Double Pitch Roller Chain with a D-1 attachment

Rex Chabelco Steel Chain . . . best where loads are heavier or where operating conditions are severe.

Rex 9250 Chain . . . for carrying boxes, cartons, large cans. Will flex in two planes. Made in wear-defying Rex Z-Metal.

Rex TableTop Chain . . . a flat, level carrying surface, ideal for cans, bottles, jars, small parts and packages.

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For effective protection of equipment . . . for longer service life at lower power costs, investigate Shafer Self-Aligning Roller Bearings. Combining all the advantages of ball and roller bearings, these efficient units are your best choice for economical service.

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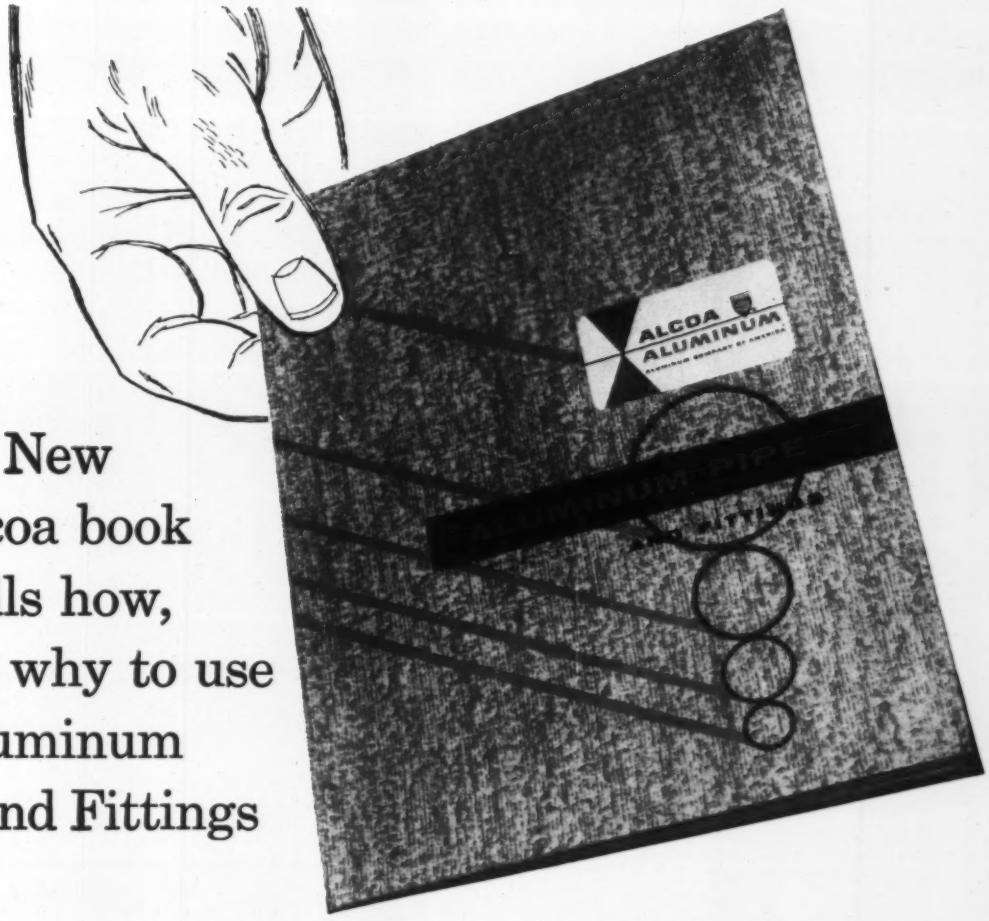

New Alcoa book tells how, where, why to use Aluminum Pipe and Fittings

ALCOA Aluminum Pipe is being used in more applications—solving more and more problems than ever before. That's because ALCOA Aluminum Pipe offers three important advantages: (1) Its low price makes it the least expensive material to use for special-purpose piping; (2) Its lightness makes it ideally suited for quick, economical installation; (3) Its durability keeps maintenance and replacement costs at rock bottom.

The complete story is in this new ALCOA book. Filled with useful illustrations and charts, it gives all the facts on the latest uses of ALCOA Aluminum Pipe and Fittings for:

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PORTABLE PIPING APPLICATIONS for supply or disposal lines that handle water, steam, compressed air, fuel and other commodities in such operations as construction, oil well drilling and mining.

STRUCTURAL PIPING APPLICATIONS for use as railings, fence posts, playground equipment, storage racks and scaffolds, and other outdoor uses.

All this plus detailed information on fittings and flanges, valves, installation procedures, and eight helpful tables to aid you in selecting the *right* ALCOA Aluminum Pipe for your need.

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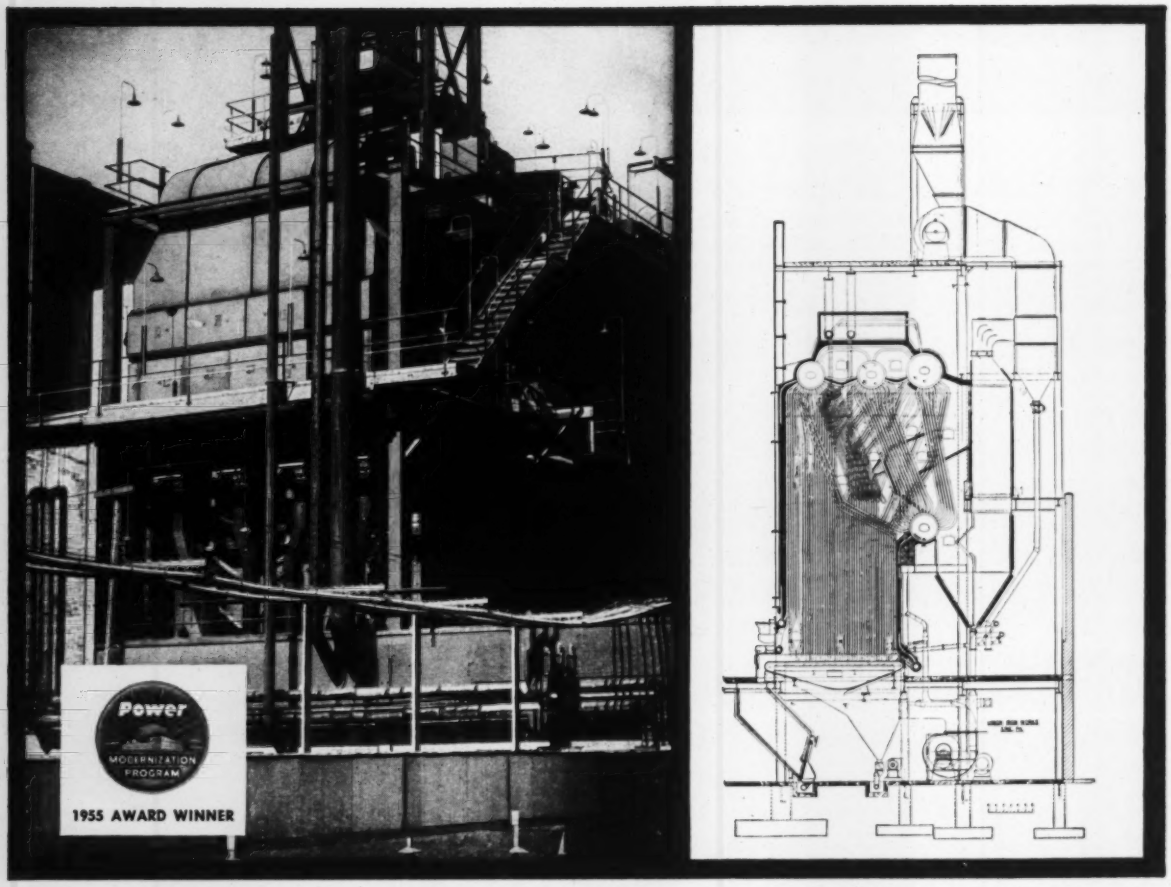


John Strange Paper Co., Menasha, Wisconsin

Longitudinal Section of Union Boiler

165,000 lbs/hr Union Boiler plays key role as John Strange wins power modernization award

Named 1955 winner of POWER Magazine's Modernization Award, John Strange Paper Company is ranked with the leaders in its industry on the basis of BTU's used per ton of paper produced.

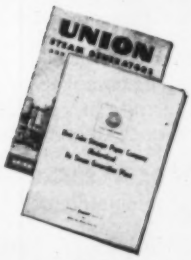
In remodeling its power plant, John Strange followed the recommendations of Cummins and Barnard, Inc. A Union 4-drum boiler was installed to supply steam for both electrical power and processing.

With a steaming capacity of 165,000 lbs/hr at 725 psig and 825° F, this Union semi-outdoor boiler has played a key role in helping boost paper production 10% while saving 29% in fuel costs without increasing plant personnel.

From start to finish, the report "How John Strange Paper Company Modernized Its Steam Generation Plant" is an interesting example of planning power services around a process. It typifies the way in which Union Boilers perform in numerous industrial installations from coast to coast.

GET FULL DETAILS

Both a copy of this story, as it originally appeared in POWER, plus illustrated Catalog GB-153 showing several types of boilers built by Union, will be mailed on request. Write.



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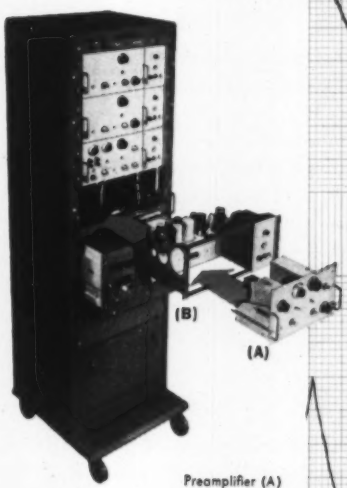
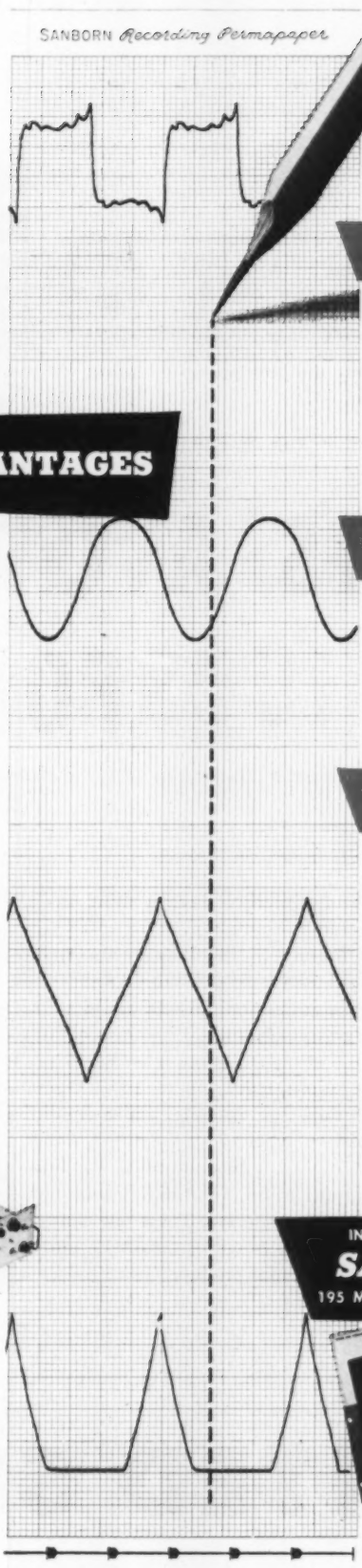
ALL SANBORN 150 SERIES OSCILLOGRAPHIC RECORDERS PROVIDE THESE

SPECIFIC ADVANTAGES

THE three foremost operating advantages of a Sanborn "150" are evident in the record, and are given at the right. Equally popular with industrial users is the *wide versatility* of these systems. Each one comprises a basic assembly to which the user adds his choice of an interchangeable, plug-in type preamplifier for each channel. Presently available different preamplifiers now number *eleven*.



Preamplifier (A) shown in position to plug into a Driver Amplifier with Power Supply (B) which are normally already in place in the Basic Cabinet Assembly



RECTANGULAR COORDINATE RECORDING

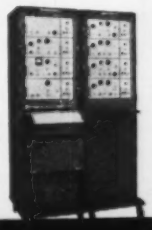
is a Sanborn feature that is especially valuable in multi-channel recording. The user of a 2-, 4-, 6- or 8-channel "150" system can record interrelated events simultaneously on one strip of record paper, and then correlate them against time quickly and accurately, even during the recording.

CLEAR, SHARP, INKLESS TRACINGS

The nichrome ribbon tip "150" heated stylus removes the white opaque surface of Sanborn recording paper (Permapaper) permitting the black undercoating to show. Tracings are permanent, will not fade or smudge.

IMPROVED OVER-ALL LINEARITY

resulting from current feedback design of Driver Amplifiers and new shorted coil frame, high torque (200,000 dyne cm.) galvanometers. Maximum error over middle 4 cm. of chart: 0.25 mm . . . over entire 5 cm. chart width: 0.5 mm.



Sanborn "150" Series available in 1-, 2-, 4-, 6- and 8- Channel Systems.

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SANBORN COMPANY
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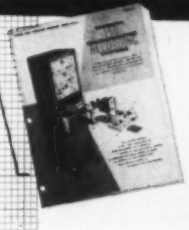


A new "150" Catalog provides complete descriptive data, specifications and prices on all 150 Systems, Accessories and Cabinets. A copy will be sent on request.

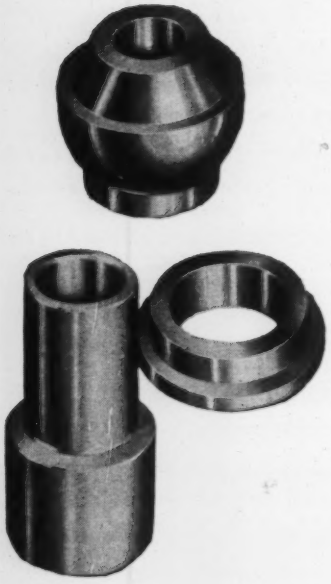
what are your bearing requirements?

A different demand . . . or set of demands . . . is made of bearings in every different product. Chief considerations may be: minimum noise level . . . corrosion resistance . . . low unit cost . . . wear resistance to oscillating or sliding motion . . . operation in presence of moisture . . . or others. When considering a sintered metal bearing for your product, it is essential that you obtain the correct alloy. The wide range of GRAMIX alloys, together with the long experience of our engineering staff in working with bearing applications, assures you of getting the best possible bearing for your product.

THERE IS A GRAMIX®

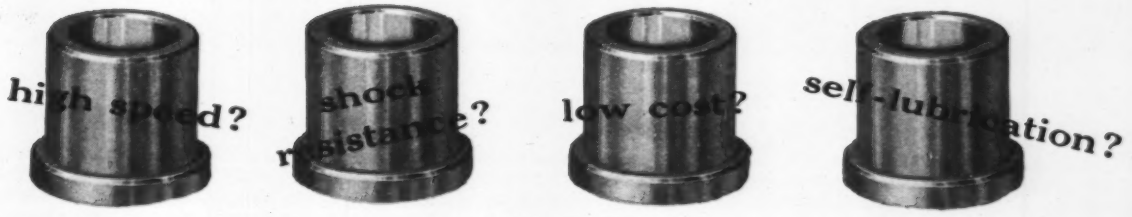
(A PRODUCT OF POWDER METALLURGY)

FOR YOUR

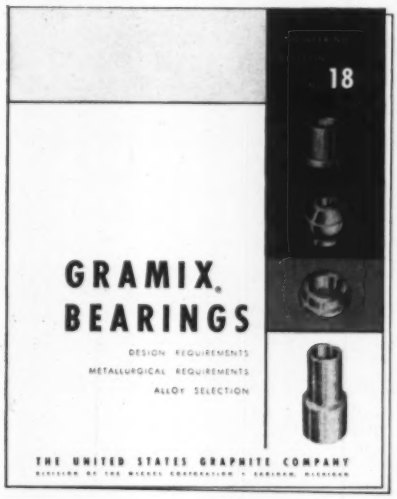


Certainly, there is such a thing as a "general purpose" sintered bearing alloy . . . GRAMIX Grade 81 fills this role, and does it well. But there are also applications that demand special alloys, designed to do a specific job better. There is a wide range of GRAMIX alloys to meet every individual design consideration. Properties of these alloys vary widely: tensile strengths range from 8,600 psi to 25,000 psi . . . elongations from 1% to 10%! Operating characteristics also vary. For example, under conditions where there is minimum lubrication, GRAMIX Grade 183 (copper, tin, lead, nickel) is recommended. For heavy duty operation in a surplus of oil, GRAMIX Grade 307 (copper, tin, lead, carbon) is preferred. These few facts convey an idea of the wide design range of GRAMIX alloys. There is *one* that exactly fits your product . . .

THE UNITED STATES



BEARING ALLOY DESIGN REQUIREMENTS



ENGINEERING BULLETIN No. 18

A NEW GRAMIX ENGINEERING BULLETIN TO HELP THE PRODUCT DESIGNER IN SPECIFYING SINTERED BEARINGS

Product engineers who specify bearing materials will find Engineering Bulletin No. 18 of great help. It presents in concise form much of the knowledge we have accumulated since 1924, when GRAMIX was first produced. Design requirements, metallurgical considerations, and alloy selection are all discussed. A table of data on GRAMIX alloy composition and physical characteristics such as density, tensile strength, elongation, and radial crushing strength is included. The section devoted to selecting the right GRAMIX alloy to fit greatly differing product requirements is an ideally simplified guide to this complex subject. Write for your copy of Engineering Bulletin No. 18 today.

113

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

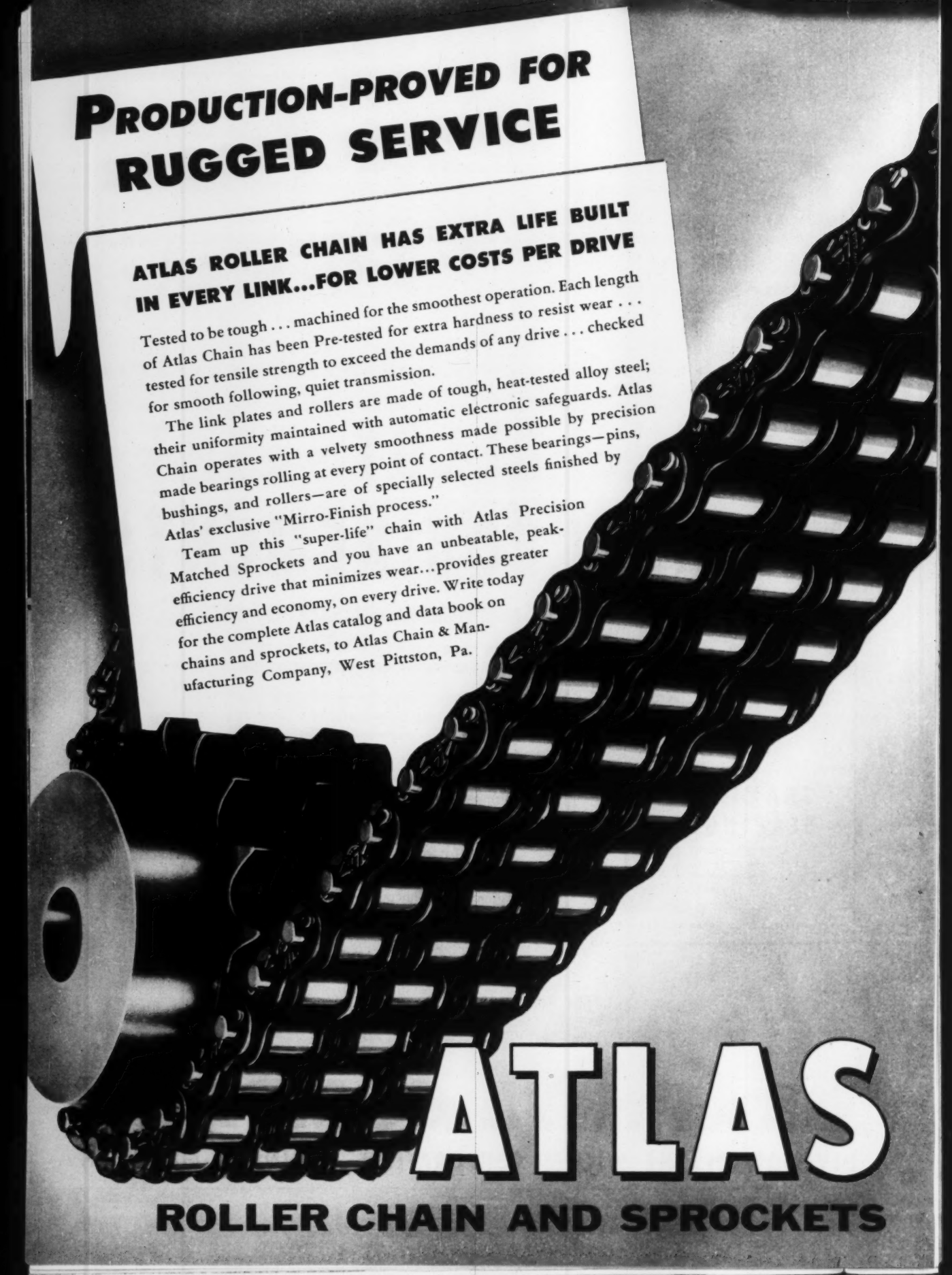
PRODUCTION-PROVED FOR RUGGED SERVICE

ATLAS ROLLER CHAIN HAS EXTRA LIFE BUILT IN EVERY LINK...FOR LOWER COSTS PER DRIVE

Tested to be tough . . . machined for the smoothest operation. Each length of Atlas Chain has been Pre-tested for extra hardness to resist wear . . . tested for tensile strength to exceed the demands of any drive . . . checked for smooth following, quiet transmission.

The link plates and rollers are made of tough, heat-tested alloy steel; their uniformity maintained with automatic electronic safeguards. Atlas Chain operates with a velvety smoothness made possible by precision made bearings rolling at every point of contact. These bearings—pins, bushings, and rollers—are of specially selected steels finished by Atlas' exclusive "Mirro-Finish process."

Team up this "super-life" chain with Atlas Precision Matched Sprockets and you have an unbeatable, peak-efficiency drive that minimizes wear...provides greater efficiency and economy, on every drive. Write today for the complete Atlas catalog and data book on chains and sprockets, to Atlas Chain & Manufacturing Company, West Pittston, Pa.



ATLAS

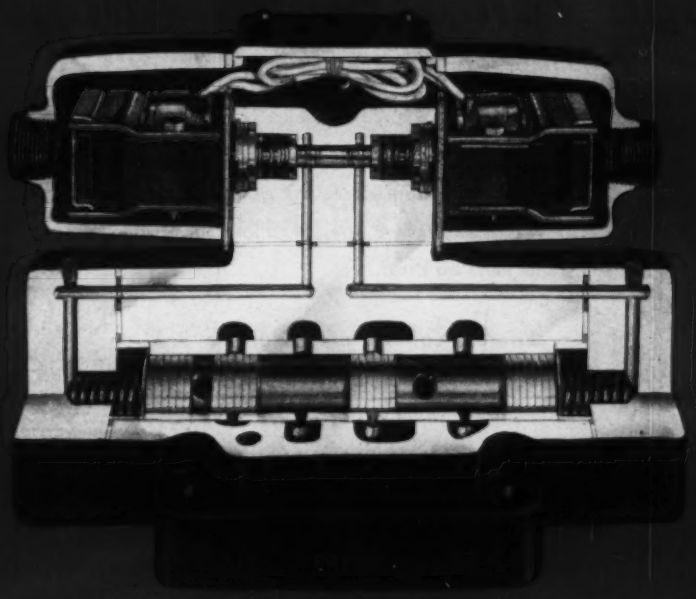
ROLLER CHAIN AND SPROCKETS

A product of CONTINUOUS RESEARCH and DEVELOPMENT

NEW RACINE

Twin Solenoid — Pilot Operated

4-WAY VALVE



Balanced Piston -- Sleeve Type -- 2000 psi Working Pressure

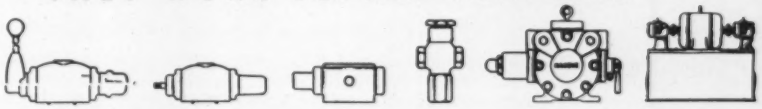
This design offers Solenoid Control, Pilot Operation, Subplate mounting, and allows unusual versatility with conversion to either spring centered, spring offset, or no spring. Solenoids are enclosed and secured to the valve in removable dust proof covers. Electrical operation is prevented when the covers are not in place. This feature promotes safety, and contributes to low maintenance.

Large openings permit a maximum flow of oil through the valve at a minimum pressure drop. This valve conforms to J. I. C. specifications and standards.

Write for catalog giving complete details and features. Address **RACINE HYDRAULICS & MACHINERY, INC.,** 2076 Albert St., Racine, Wisconsin.

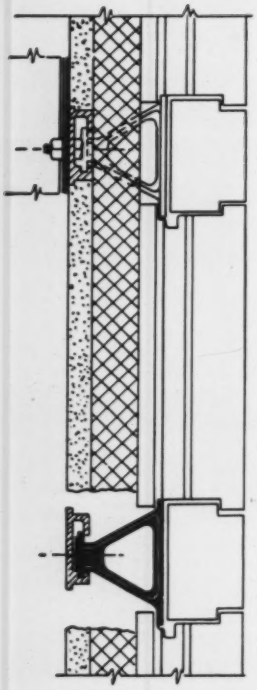
RACINE — STANDARD FOR QUALITY AND PRECISION — RACINE HYDRAULICS & MACHINERY, INC.

"THEY WORK BETTER TOGETHER"



INTRODUCING
BIGELOW-LIPTAK'S
BI-MET*

Insulated Furnace Walls For High Temperature Applications

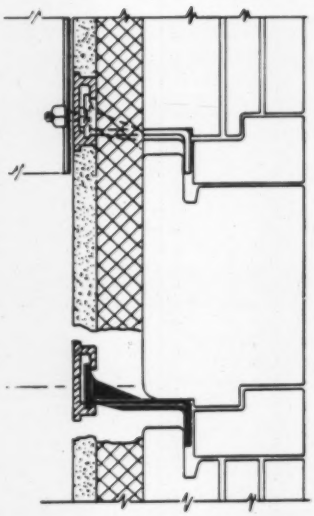


The 4½ inch wall

Here's a job-proven idea which is designed to pare the costs of suspended furnace enclosures. It's used when temperatures are going to be high and when expensive special alloy supporting castings must be used.

Two different castings are used. The first, an alloy clip casting is embedded in the tile where temperatures are highest. This, in turn, is fastened to a standard cast iron support. The design permits the most economical use of costly alloys.

This is a Bigelow-Liptak BI-MET wall and it is another example of B-L's efforts to produce quality furnace enclosures at lower and lower initial costs. Remember: a suspended enclosure for a boiler, a refinery heater, or any other type of installation, will *last longer, have less down time for repairs.* That makes a suspended job the cheapest in the long run. Want to cash in on savings like these? Contact the B-L office nearest you.



The 7 inch wall

*PATENT APPLIED FOR

BIGELOW-LIPTAK *Corporation*

AND BIGELOW-LIPTAK EXPORT CORPORATION
2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MIAMI • MINNEAPOLIS • NEW YORK • PHILADELPHIA • PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE • TULSA • MONTREAL • SAULT STE. MARIE, ONT. • VANCOUVER • WINNIPEG

Architects & Engineers: **Welton Becket & Associates** • General Contractor: **Del E. Webb Construction Co.** • Plumbing Contractor: **Scott Co.** • Plumbing Wholesaler: **Grinnell Co. of the Pacific**

No need to dip your toe in this king size pool to test its temperature. Just dive right in and enjoy its filtered, comfortable water. It's thermostatically controlled by Powers.

In the Sumptuous **BEVERLY HILTON**

BEVERLY HILLS, CALIFORNIA

POWERS **THERMOSTATIC CONTROLS**
Regulate Temperature of Swimming Pool, Showers, Shampoos and Water Heaters

With its new world standards for hotel luxury, service and hospitality, the Beverly Hilton has provided its guests with the ultimate in comfort and safety in its Powers thermostatically controlled showers, shampoos and swimming pool.

More Powers to You when you want controls of superior quality that give years of dependable performance. Benefit from Powers more than 60 years of experience in temperature control. Call our nearest office or write us direct for aid in selecting the right type of control for your requirements.

(c47)

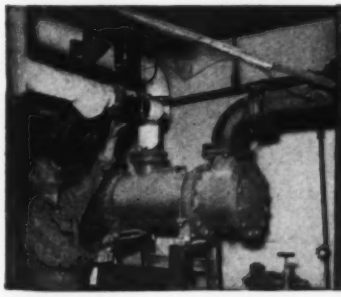
Safe, Comfortable Showers, 450 of them in the hotel and colorful pool side cabanas, are thermostatically regulated by Powers. There is no danger of scalding or unexpected shots of cold water.

No Danger of Scalding in the Barber Shop Shampoos. They're safetyized by Powers.

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico*

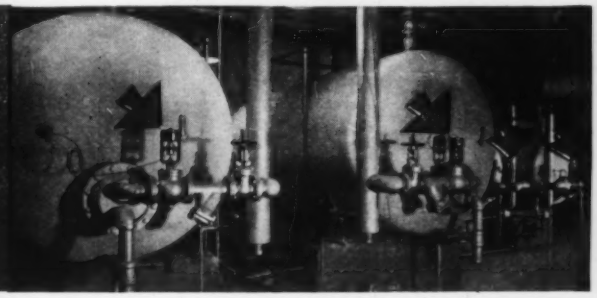
Over 60 years of Automatic Temperature and Humidity Control



5 of the 8 Powers Controlled Water Heaters

Heat Exchanger, left, supplies properly tempered water to swimming pool.

Water Storage Heaters, right, are also controlled by Powers No. 11 Self Operating Temperature Regulators.



TUBE or SHAPES...

when you want ALUMINUM you'll want WOLVERINE

Here's why

TUBING —You can use Wolverine *drawn* aluminum tube where close tolerances and high physical properties are required. And you can save money with Wolverine *as-extruded* tube for most applications where tolerances are not as critical. Both are available in straight lengths, coils, and extra-long coils.

EXTRUDED SHAPES —Wolverine extruded aluminum shapes will meet exacting requirements—will help reduce machining and assembly operations, cut weight, and save on materials.

QUALITY —Wolverine stands behind the quality of its products with this statement—"Wolverine's product and service quality is that which meets our customers' stated requirements." This assures you product satisfaction.

SIZES AND ALLOYS —Wolverine aluminum tubing and extruded shapes are available in a wide range of sizes in popular alloys and tempers.

PACKAGING —Tubing and shapes are packaged to meet your production line requirements—help reduce material handling—speed up production flow.

WOLVERINE TUBE, 1483 Central Ave., Detroit 9, Mich.

NEXT TIME YOU ORDER ALUMINUM TUBE OR SHAPES SPECIFY WOLVERINE—

Count on WOLVERINE TUBEMANSHIP

Write today for your copy of the Wolverine Aluminum Catalog

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Visit our Booth 422 at the Design Engineering Show, May 14-17 in Philadelphia

DIVISIONS OF CALUMET & HECLA, INC.

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Division of Calumet & Hecla, Inc.

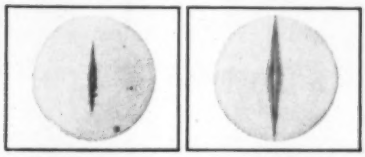
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA • SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPT., 13 EAST 40TH ST., NEW YORK 16, N.Y.

A composition that is almost twice as hard as the hardest steel . . . KENNAMETAL*

Kennametal is the registered trademark of a series of hard alloys of tungsten, tungsten-titanium, and tantalum carbides. These compositions are the *hardest* practicable metals made by man. In scratch hardness tests, these hard carbide particles are between sapphire and diamond. On the Rockwell "A" Scale, different Kennametal grades test from 90.0 to 93.0, while that of HSS 18-4-1 heat-treated steel tests a maximum of 85.0. The Knoop Test

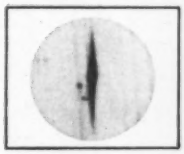


K8 Tungsten carbide — 18-4-2 Steel

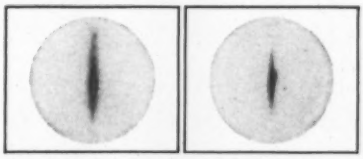
gives 2100 (K100) for Kennametal and 800 (K100) for steel.

Photomicrographs above show results of Knoop hardness test on Kennametal K8 (left) and HSS 18-4-2 steel (right) at 100g. Impression in the Kennametal is only about half of that on the steel.

Photomicrographs below are of Knoop tests on grains of carbide ingredient of Kennametal. Knoop test numbers (at 100g) are: tungsten carbide, 1900; tungsten-titanium carbide, 2200; titanium carbide, 2500. These tests show those carbides are from two to three times as hard as steel in the absolute scale of Kgs per square mm of area of impression.



Tungsten carbide

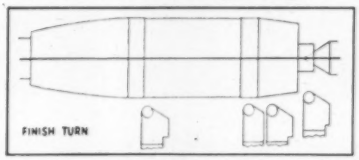


Tungsten-titanium carbide — Titanium carbide

Extreme Hardness of KENNAMETAL Utilized by Designers

A West Coast manufacturer switched to solid Kennametal tungsten-titanium carbide tools for internal threading of stainless steel rings, jumped production from 35 to 40 pieces between grinds to 80 to 100 pieces with Kennametal. And the latter showed no cratering and only slight edge wear requiring only light grinding.

A manufacturer of aircraft landing gears uses the hardest grade of Kennametal cutting edges for interrupted cutting of SAE-4340 steel (220,000 psi tensile strength), at 1½ times greater speeds and with over 10 times longer tool life. Both sides of 54 pieces are rough cut and finish cut between grindings.



2400 to 3600 (depending on shell hardness) 90 mm shells are finished-turned using the hardest grade Kennametal before regrinding is required.

Perhaps KENNAMETAL's Extreme Hardness Can Help You, Too

Together with absolute hardness goes surprisingly greater resistance to wear and deformation. It is vital to innumerable industrial applications. Perhaps it is the characteristic you need to get YOUR idea off the drawing board and into production. It is worth investigating. Write to KENNAMETAL INC., Latrobe, Pennsylvania, and ask for Booklet B-111.

*Registered Trademark

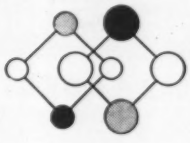
SEE OUR EXHIBIT
Booth 313
at the Design Engineering Exposition
MAY 14-17
Convention Hall
Philadelphia, Pa.

Come in and visit us while you are in Philadelphia. See "live" demonstrations that prove the many outstanding characteristics of Kennametal and Kentanium (the titanium carbide for application at 1800° F and above). See such demonstrations as:

- The Torque Test
- The Hardness Test
- The Deflection Test
- The Vibration and Chatter Tests

Inspect dozens of sample machine and processing equipment parts made from Kennametal and Kentanium . . . typical applications being used in practically every industry. Our engineers will be glad to talk over any of your problems and advise how you may use these hard, strong metals to advantage.

B-9926



INDUSTRY AND
KENNAMETAL
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Where a Job Well Done JOINS HANDS

The veteran RIC-WIL field supervisor and contractor join hands in a JOB WELL DONE. Expert field service is available on all RIC-WIL installations.

There is satisfaction in achievement . . . the knowledge that *BOTH* the supplier and the buyer have given their best . . . and the best in Prefabricated Insulated Piping for underground and overhead systems is RIC-WIL. The next time you specify . . . specify Quality . . . specify RIC-WIL.

Write or phone your nearest representative or send for the illustrated RIC-WIL catalog.

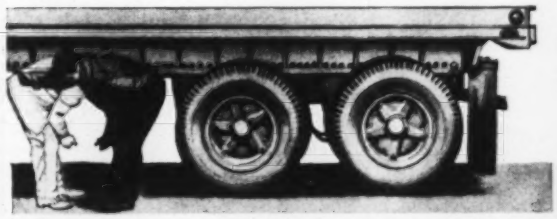
Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL INCORPORATED

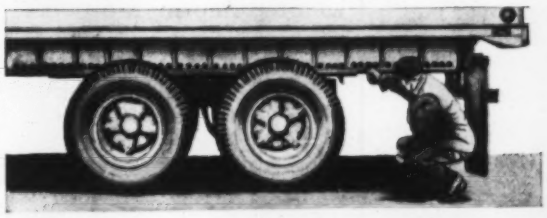
PREFABRICATED **INSULATED PIPING SYSTEMS**

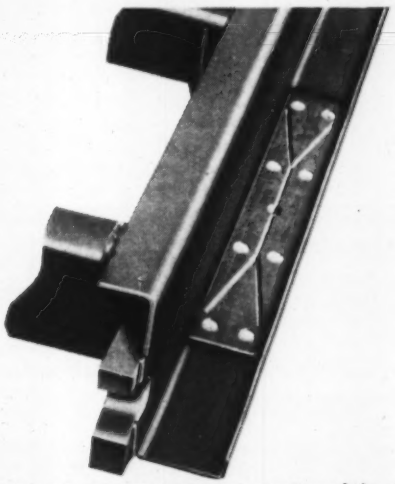
BARBERTON, OHIO

Wrought Everdur* Cuts Cost in Half



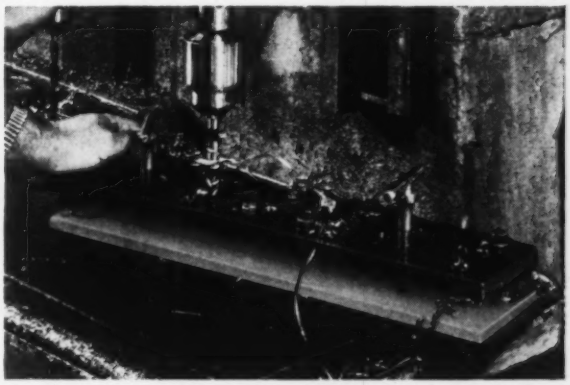
THE TRAILMOBILE SHIFTABLE TANDEM—Truckers often lose time and money in shifting trailer cargo, changing tractors, or cutting payload to meet legal axle-weight requirements. Now, however, they can balance any load in just five minutes by moving the Shiftable Tandem Axle Assembly made by Trailmobile Inc., Cincinnati, Ohio. The axle assembly slides forward or backward, as needed, along a stainless steel rail on four shoes of wrought Everdur. It can move 66 inches and be locked at 3-inch intervals by locking rods through holes in the rail.



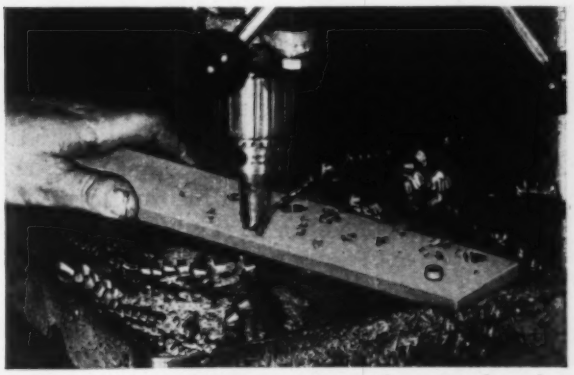


EVERDUR CAN TAKE THE LOADS AND SPLASH—One of the shoes of wrought Everdur installed in the Shiftable Tandem frame. An Alemite fitting in center hole and oil grooves provide lubrication. The Everdur shoes carry normal tandem loads of 32,000 pounds day and night, and slide freely under this pressure. Resistance to corrosion is another reason why Everdur was selected, for unlike the trailer's cargo, the Everdur shoes are exposed to road splash of varied mixtures.

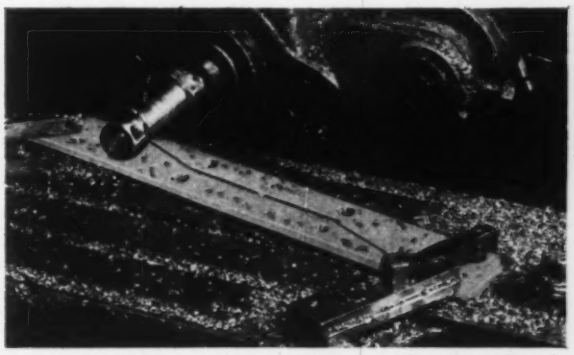
Wherever metal must resist corrosion, be strong and tough, and be available in forms easily fabricated, consider Everdur, Anaconda's family of copper-silicon alloys. The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. *Reg. U.S. Pat. Off. 5661



HOW WROUGHT EVERDUR CUT MATERIAL COSTS—Trailmobile first tried high-tin bronze castings for the shoes on which the assembly slides. But rejects for porosity and warpage in the thin cast section were a costly problem—and all surfaces had to be finish-machined. The wrought Everdur bar stock suggested by Anaconda's technical experts has surfaces satisfactory as delivered—ready for drilling holes (shown above).



HOW WROUGHT EVERDUR CUT LABOR COSTS—The castings formerly used were not uniform. Hard spots made surface machining difficult and expensive. The entire operation was unnecessary with wrought Everdur bar stock—reducing labor cost by about 50 per cent. (Above) Countersinking holes for screw fastenings.



WROUGHT EVERDUR IS READILY MACHINABLE—Though tough and dense, wrought Everdur is uniform and poses no special problems in machining. Oil grooves are shown being milled in the shoes.

EVERDUR

ANACONDA® COPPER-SILICON ALLOYS

Pumping Progress Report

FOR MECHANICAL ENGINEERS

An advertisement prepared by the Aldrich Pump Co., Member of Hydraulic Institute, U.S.A.

PROVIDING SMALL VOLUMES OF HYDRAULIC POWER at low, medium or high pressures is a problem frequently encountered by hydraulic engineers. Often, in the past, this was economically infeasible. Not so today, however.

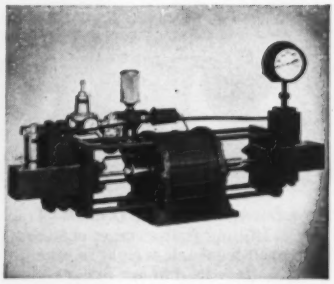
NORMAL PLANT COMPRESSED AIR is now utilized to operate small hydraulic pumps for production or laboratory use. These units are ideal for testing tubing, valves or pressure vessels and supplying power for die casting, plastic molding or belt presses.

ALDRICH AIR-DRIVEN HYDRAULIC PUMPS are completely self-contained; absolutely no auxiliary equipment is needed where air pressure is available. Each unit is fitted with an air filter, regulator, lubricator and hydraulic pressure gauge. Hydraulic plungers are available in sizes from 5/8-in. to 3-in. diameters.

HYDRAULIC PRESSURES are controlled by simple air regulator adjustment. Pressures as low as 103 psi are possible with a 3-in. diameter plunger utilizing 10 psig air pressure or as high as 37,000 psi with a ½-in. plunger utilizing 100 psig air pressure. Between these two extremes falls most of the work for which small volumes of hydraulic power are specified. Special units are available for higher pressures.

INSTALLATION of air-operated hydraulic pumps is simple. The air cylinder is bolted to a foundation, and pump suction, pump discharge and air inlet lines are connected. The units occupy a minimum of space; the air cylinder base is only 12½-in. x 14-in.

COMPLETE DETAILS of the ALDRICH Air-driven Hydraulic Pump are described and pictured in Data Sheet 36, which will be sent at your request. Address: The Aldrich Pump Company, 29 Pine Street, Allentown, Pa.



Aldrich Air-driven Hydraulic Pump

. . . for your tough pumping problems specify ALDRICH

One of the many tough pumping problems frequently faced by Aldrich engineers is that of supplying small volumes of hydraulic power at low, medium or high pressures.

In answer to this problem, Aldrich developed the completely self-contained Aldrich Air-driven Hydraulic Pump. Operating from a plant's normal compressed air supply, it can produce hydraulic pressure up to 23,700 psi, making it ideal for production or laboratory use.

Typical Applications for Aldrich Air-driven Hydraulic Pumps:

Testing: Tubes, Valves, Pressure vessels
Providing power for: Die casting, Plastic molding, Belt presses

Write today for Data Sheet 36 describing the Air-driven Hydraulic Pump.

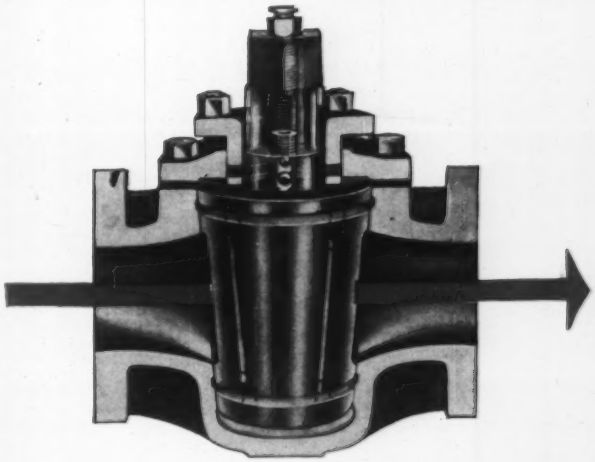
THE ALDRICH PUMP COMPANY

Originators of the Direct Flow Pump
29 PINE STREET
ALLENTOWN, PA.
Representatives in principal cities

Straightway

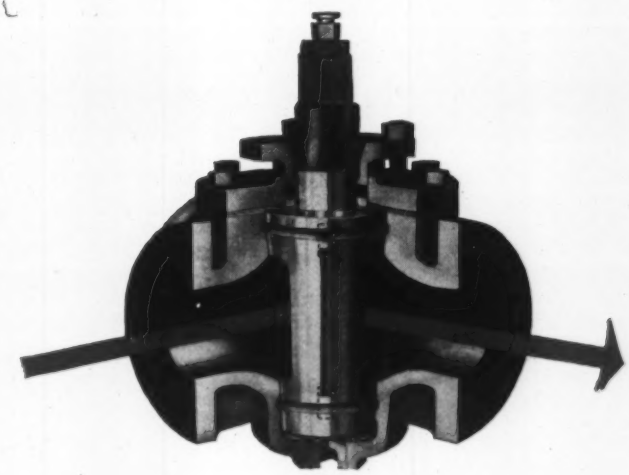
Leakproof Rockwell-Nordstrom Straightway valves cost you no more to buy and far less to use than any other valve. The exclusive Sealdport* lubrication system saves you important dollars in maintenance by eliminating the metal-to-metal friction that wears out other valves so quickly. Expensive seating problems are eliminated on even the toughest service because the Rockwell-Nordstrom valve seats are never *exposed* to the line fluid. Available in a complete range of sizes and pressure ratings in steel, semi-steel, stainless and other corrosion resisting metals.

*Registered trade mark, Rockwell Manufacturing Co.



Two ways to
Cut Your Valve Costs

ROCKWELL-Nordstrom Straightway and Multiport **VALVES**



Multiport

For such services as tank switching, relief, and blending, Rockwell-Nordstrom Multiport valves stop or change flow on three or four lines. You not only get perfect flow control but you save the cost of three or four ordinary valves . . . piping arrangements are simpler and less costly, too. Lubrication and unexposed seating assure lowest maintenance—longest service, just as in the Straightway pattern above. Rockwell-Nordstrom Multiport valves are available in semi-steel, steel, stainless and corrosion resisting metal in a wide range of pressure ratings and sizes to 16″. Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Valve Licensee:* Peacock Brothers Limited.

ROCKWELL-
Nordstrom
VALVES

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MAY 1956

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Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Street, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members annually $3.50, single copy 50 cents, to nonmembers annually $7.00, single copy 75 cents. Add $1.50 for postage to all countries outside the United States, Canada, and the Pan-American Union. Changes of address must be received at Society headquarters seven weeks before they are to be effective on the mailing list. Please send old as well as new address... By-Laws: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4).... Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879.... Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921.... ©Copyrighted, 1956, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulation. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author and that date of publication be stated.

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.

MECHANICAL ENGINEERING

Practical Considerations in Designing Railway Passenger Cars . . . . . *A. G. Dean* 410
Electronic Computers Solving Production-Engineering Problems . . . . . *C. R. De Carlo* 416
Relating Materials-Handling Costs to Over-All Production Costs . . . . *B. W. Saunders* 419
Application of Superheated-Vapor Atmospheres to Drying . *A. M. Lane and Stuart Stern* 423
The Engineer Looks at Management Positions . . . . . *R. P. Kroon* 427
Utilities Systems for a 30,000-Barrel-Per-Day Refinery . . . . . *C. E. Peterson* 430
The Shortage Re-Examined . . . *J. R. Killian, Jr.* 433

Editorial 409

Briefing the Record 440

200,000-Kw Turbine-Generator Unit, 440; OVEC Power Project, 443; Evaporograph, 443; Gas-Turbine Car, 444; Gas-Turbine Boat, 445; Three-Stage Rocket, 446; Inflatable Airplane, 446; Flight-Instrument System, 447; Overhead Monorail Transit System, 448; Civilian Atomic Power Plants, 448; Engineering and Scientific Manpower, 449; Fail-Safe Monitoring Systems, 450; High-Titanium Carbide, 451; Vertical Automatic Chuckers, 452; Air-Conditioning Research, 453; Engineering Developments at a Glance, 454

European Survey 456

Generator-Rotor Construction, 456; Reconstructing a Steel-Melting Shop, 457; Shifting Oil Storage Tanks, 457; Fifth World Power Conference, 457

ASME Technical Digest 458

Hydraulics, 458; Metal Processing, 459; Lubrication, 460; Heat Transfer, 460; Instruments and Regulators, 460; Machine Design, 461; Materials Handling, 462; Fuels Technology, 463; Production Engineering, 464; Oil and Gas Power, 464; Rubber and Plastics, 464; Power Test Codes, 464; Availability List for 1956 ASME-IRD Conference Papers, 464; ASME Transactions for April, 1956, 465

Comments on Papers 466

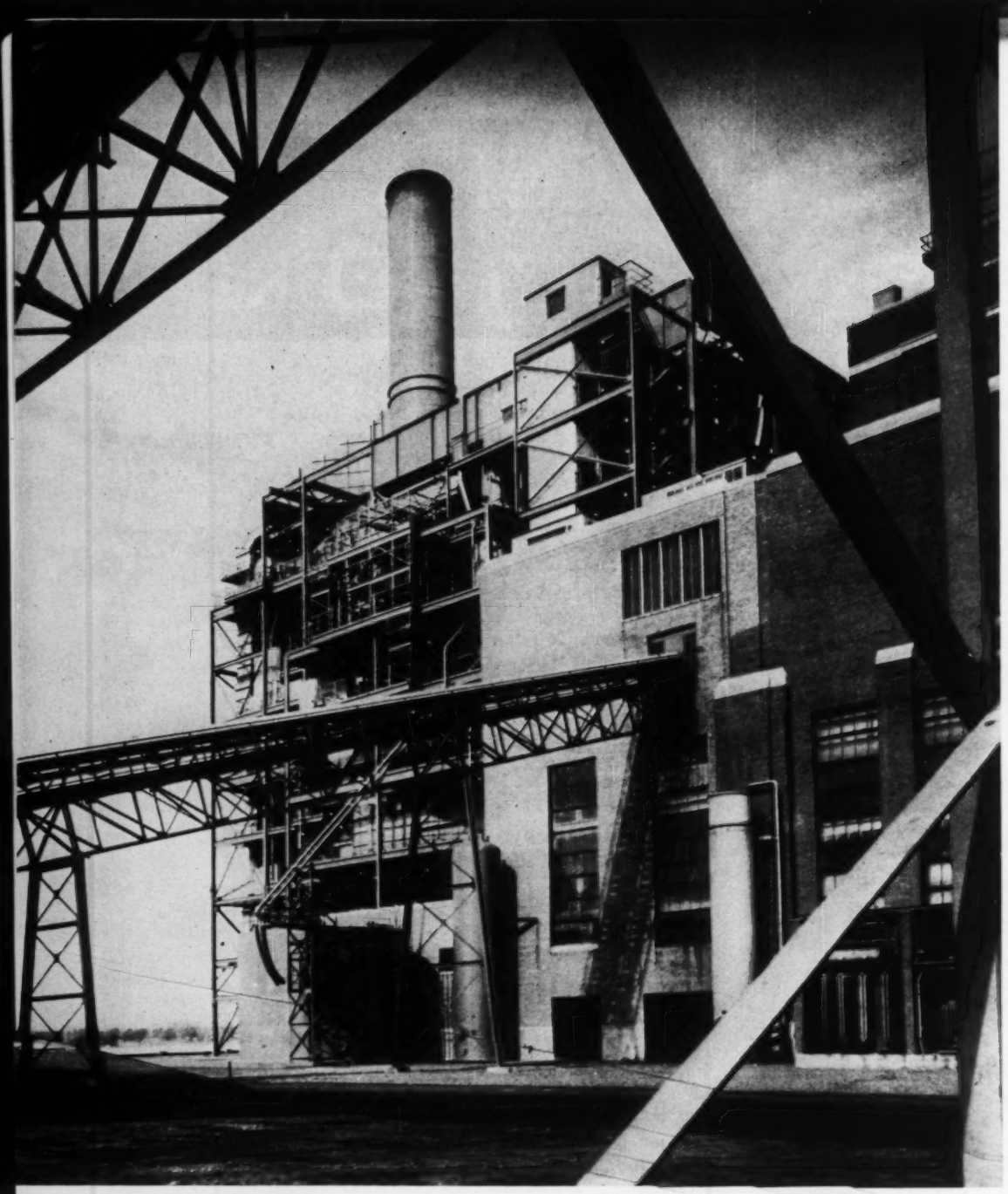
Reviews of Books 469

ASME Boiler and Pressure Vessel Code 471

ASME News 472

What of Tomorrow? 472; West Coast Engineering Management, 474; ASME Semi-Annual Meeting Program, 475; ASME Applied Mechanics Program, 479; ASME Membership, 480; ISO TC/11 Conference, 481; ASME Engineering Management Conference, 482; ASME Coming Events, 482; ASME Aviation Conference, 483; ASME Spring Meeting, 485; J. W. Barker, ASME President, Urges Education Survey, 490; ASME-IRD Conference, 490; ASME OGP Conference, 491; Meetings of Other Societies, 493; Coming Meetings, 493; Junior Forum, 495; ASME Executive Committee Actions, 496; Personnel Service, 497; Candidates, 498; Obituaries, 500

Classified Advertisements . 145 *Consultants* . . . 162
Advertisers 164



New 200,000-kw turbine-generator unit . . .

. . . recently completed at Burlington Generating Station, Burlington, N. J., by Public Service Electric and Gas Company increases the system's electric capacity to 2,104,300 kw. Featuring elevated steam conditions, the unit costs about $31,500,000. For further details see pages 440–443.

Volume 78 • Number 5

MAY 1956

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George A. Stetson, *Editor*

MECHANICAL ENGINEERING

EJC Reports Its Activities

THE ENGINEERING profession has continually searched for a means to effect unity of action in problems of broad professional and public concern. Recent progress toward this end is noted in the 1955 Annual Report of Engineers Joint Council, now available.

On the basis of recommendations made in 1952 by an exploratory group of some 15 national societies the Engineers Joint Council, founded in 1945, was reorganized in its present form. The constitutional changes then effected have in three years converted EJC, which originally comprised the four Founder Societies and the AIChE, into an association of 11 engineering societies or federations with a membership of over 200,000. And it is still growing.

Thorndike Saville, 1955 EJC president, points out in the current report, that in addition to a number of engineering societies or groups that have become members of EJC in some category, several more have applied for, or have made inquiries about, affiliation.

According to the report, committees have increased in number as new problems have arisen affecting the profession and its responsibilities to the public. One of the activities of EJC which has received wide acclaim both from the profession and from nonengineering groups, has been the work of the Panel on National Water Policy. Because several of its members were closely associated with the Hoover Commission Task Force on Water Resources and Power, the Panel recommended and the Board of EJC approved the creation of an ad hoc Board of Review on National Water Policy to consider the recommendations made in a number of important reports dealing with water resources which have appeared since the EJC report in 1951.

EJC committee action has been impressive on many other fronts. For example, the Engineering Manpower Commission has had substantial influence in awakening the Congress and the public to a realization of various facets of the manpower shortage problem. The Committee on International Relations has effectively represented the engineering profession in this country with its colleagues abroad, particularly in South America. It has acted as agent for United States sections of international engineering groups. The Committee on Constitution and By-laws has devised improvements which have been adopted. The Committee on Employment Conditions has spent much time and effort on a controversial and difficult subject. The National Engineers Register has proceeded according to plan in co-operation with the National Science Foundation. Other committees and groups have been active and productive.

Of note was the first Nuclear Engineering and Science Congress held in Cleveland, Ohio, Dec. 12–16, 1955. The technical program plus an outstanding exposition was co-ordinated by EJC on behalf of 26 engineering and scientific groups.

The more than 250 technical papers covered some 50 fields of nuclear engineering and opened new avenues for the peaceful application of atomic developments.

The wide scope of activities covered by EJC as evidenced in the 1955 report clearly indicates that EJC can be a mechanism which in line with its objectives might bring to bear the full weight of the profession upon social and economic problems affecting engineers or upon public policy invested with engineering aspects.

The objectives of Engineers Joint Council, according to its Constitution are: To advance the general welfare of mankind through the available resources and creative ability of the engineering profession; to promote co-operation among the various branches of the engineering profession; to advance the science and profession of engineering; and to develop sound public policies respecting national and international affairs wherein the engineering profession can be helpful through the services of the members of the engineering profession.

To achieve these objectives, the Constitution states, the Council shall act as an advisory and co-ordinating agency to seek and study matters of mutual interest to the constituent societies of Council and to recommend parallel action by them; represent the constituent ties of the Council in instances in which to be desirable; societies deem such joint repre- the engineering profession, and administer on behalf authorized by a majority of the constituent societies of the Council.

those activities

The foregoing delineates the aims and purposes of EJC.

That EJC is fulfilling these objectives is clearly evident from its 1955 Annual Report, which should be of great interest to every engineer.

Therefore, to gain a better insight into the work that this forward-looking organization is doing, its contributions, and its accomplishments, it is urged that the report be widely read by members of ASME and other constituent societies of EJC. The 1955 EJC Council Report is now available from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y. Get a copy, read it, and judge for yourself.—J. J. J., Jr.

Practical Considerations in

Designing Railway Passenger Cars

Recapture of passenger traffic spurs car builders to develop improved equipment

By A. G. Dean

Assistant Chief Engineer, Railway Division, The Budd Company, Philadelphia, Pa.

THE present widespread interest in radical new railway passenger equipment has given the car builder an opportunity to develop ideas which might not have been welcome a few years ago. At the same time, it has presented the sobering responsibility to produce at least a workable prototype which will justify the considerable investment necessary for such a development. A wide diversity of approaches to the solution of the problem of recapturing passenger traffic lost to other forms of transportation has been offered and several of these are to be tried on different railroads.

One Company's Approach

The author's company, which entered the field during the last period of radical improvement, producing after a brief experimental period the *Pioneer Zephyr* and other highly successful unit trains, has been active during the present phase as well. We have developed a variety of new car types, each particularly suitable for one or more specific operating conditions. To insure good results, radical running gear requiring long periods of development with uncertain results has been avoided. Operating flexibility, the principal shortcoming of the unit trains of 20 years ago, has been emphasized insuring high annual mileage and minimum operating cost. Low first cost, consistent with low maintenance and degree of comfort required, is emphasized.

The cars themselves range from unusually high to unusually low, depending on the class of service which they are intended to perform. In many cases they are strangely conventional, indicating evolution rather than revolution, and this conventional-appearing car shows revolutionary weight saving simply by combining the best of proved components with logical refinement of present practices. The successful operation of the Budd rail diesel car (RDC) has pointed the way to a high-speed main-line motor train which should be a considerable contribution to the intermediate distance daylight-travel problem.

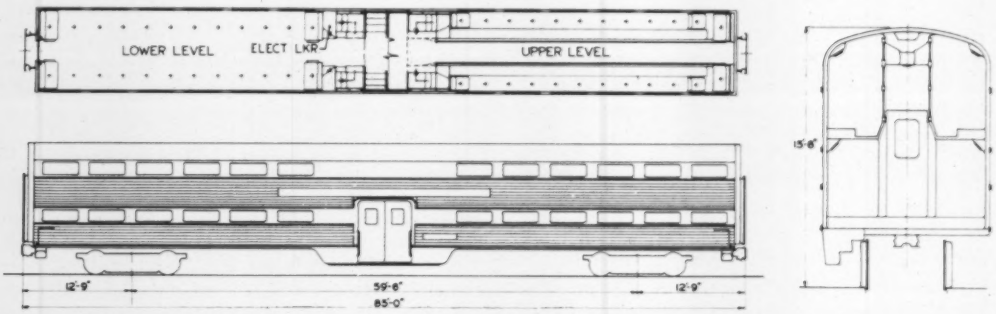

Fig. 1 Suburban coach for 148 passengers designed for C. B. & Q. Railroad to replace single-level coaches with capacity for 90 passengers

Gallery Car

The suburban coach for 148 passengers, Fig. 1, has been designed for the Chicago, Burlington and Quincy Railroad to take the place of conventional single-level suburban coaches having a capacity of approximately 90. Dimensions of the coach are given in Fig. 1. The lightweight is 131,500 lb; weight per passenger 890 lb.

If a train of four gallery cars should be drawn with a 2000-hp road-switcher diesel locomotive, the train weight per passenger would be about 1300 lb. Seven conventional-type cars would provide about same capacity but weight per passenger would increase to 1730 lb. This comparison does not compensate for increased power required for equal performance with heavier train.

Contributed by the Railroad Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 55—A-134.

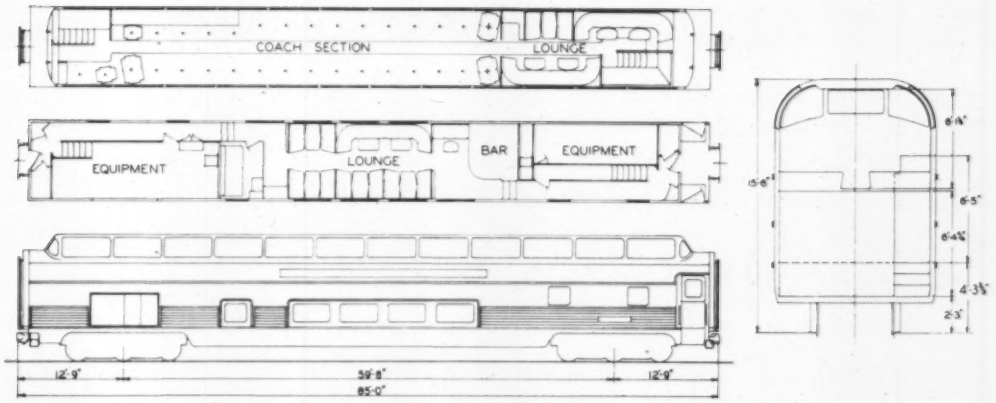

Fig. 2 Full-length dome car adopted by Santa Fe and Great Northern Railroads, developed from popular Vista-Dome type passenger car

The unusual feature of these cars is the balcony construction by which the seating capacity per car is increased. This construction permits servicing of the train by the conductor from the main aisle and quick loading and unloading are possible despite the high capacity of the car.

The structure of this car is fairly orthodox with couplers and floors at ends at standard AAR heights. AAR strength levels are exceeded moderately in every respect. The cars are arranged for head-end auxiliary power to cover electric loads other than the air-conditioning requirements. Conventional steam heating is provided.

The interior feature, of course, is the balcony construction which is supported by a truss-type hand rail which avoids the need for stanchions to support the balcony. The seating is two and two on the lower level and one and one on the upper level with a double seat at each corner of the car.

Full-Length Dome Car

The quick acceptance and high popularity of the Vista-Dome type of car led rather naturally to the development of the full-length dome car, which has been adopted by the Atcheson, Topeka, and Santa Fe Railroad as well as by the Great Northern. Details of this car, accommodating 103 passengers, are shown in Fig. 2. The lightweight is 185,000 lb, and weight per passenger, 1795 lb.

The full-length dome car replaces at least one and a half full-length lounge cars. It is difficult to compare this in weight with the equipment replaced because there is no exact equivalent. These cars are costly and heavy and normally not suitable for short runs. In transcontinental service, however, they contribute considerably to the comfort and luxury of train travel. They no doubt attract a considerable number of passengers to the railroads using them.

In this car the upper level is a dome which has been extended for the entire length of the car. Lounge- and coach-type seats are available. A second lounge is provided on the lower deck. This lounge is also luxuriously appointed with Indian decorations. A bar is provided serving the upper level also by means of a dumb-waiter.

A stairway is provided at each end of the dome section leading to a conventional vestibule at one end and to the normal floor height at the other for use in trains of conventional cars. Aisles are provided at each end past the equipment space, permitting passage through the car on the lower level.

The equipment is unusual in that each car carries its own diesel-generator source of auxiliary power. Because there is no space under the lower floor, this equipment as well as the air-conditioning equipment is carried between the floor above the truck and the upper-level floor. The voltage is 220-volt alternating current permitting the use of 3-phase a-c motors on the air-conditioning plant and permitting the use of standard a-c equipment throughout the car.

Owing to the unusual amount of glass in the roof of this car, the air-conditioning loads are very heavy. For this reason 20 tons capacity is provided. Heating is by means of conventional steam heat distributed by floor heat radiation and overhead through the air-distribution system.

High-Level Train

Table 1 gives particulars for a high-level train being built for the Atcheson, Topeka, and Santa Fe Railroad.

Each ten-car train will consist of seven high-level chair cars, a high-level diner, a high-level lounge car and a normal-height baggage dormitory. Various units are shown in Figs. 3 and 4. Without locomotive, this train will weigh about 1,619,000 lb and will replace a 16-car train of present-day lightweight chair cars, diners, and lounge cars which, for about the same capacity and facilities, would weigh about 1,985,000 lb. This train

Table 1 Details of ATSF High-Level Train

Type of car	Chair	Lounge	Diner
Length, ft-in.	85	85	85
Height, ft-in.	15-6	15-6	15-6
Capacity	72	62	84
Seat spacing, in.	50	...	...
Lightweight, lb	161000	170000	197500
Center of gravity, in.	65		
Weight per passenger, lb	2235	...	...

Fig. 3 Chair car, one of seven on the new ten-car high-level train being constructed for the Santa Fe Railroad

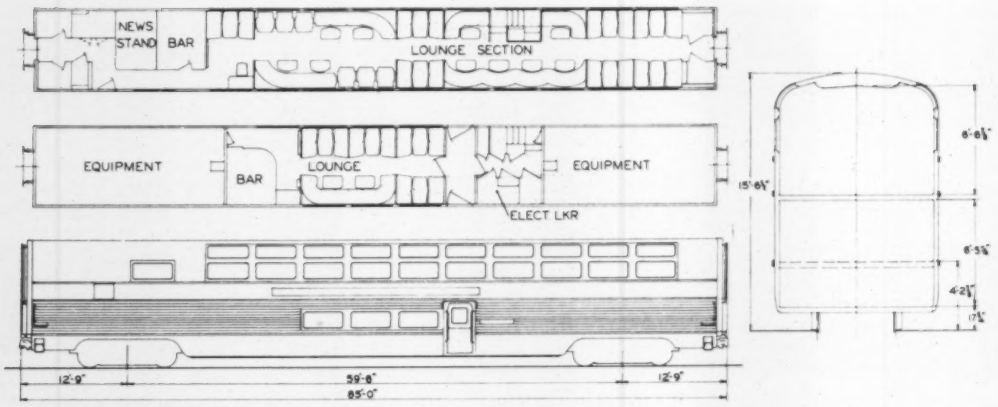

Fig. 4 This high-level sky lounge, a diner, and baggage-dormitory car, complete the Santa Fe's high-level train

is perhaps a logical development from the full-length dome. Recognizing the excellent ride and unusually low noise level of this dome car, it seemed desirable to consider carrying all of the passengers at this higher level.

The lounge car is quite similar to the full-length dome lounge mentioned previously. The diner has a full-length dining section on the upper level with the electric kitchen on the lower level with service by means of dumb-waiters between the two floors. The diner is about the equivalent of the more usual arrangement where a full-length diner is coupled to a kitchen dormitory car, except that the usual crew quarters are carried elsewhere in the train.

The chair car is arranged with a high level of luxury intended for transcontinental or overnight service. Seats are spaced at 50 in. and leg rests are provided to improve coach sleeping comfort and to provide a maximum of daytime comfort for long periods of travel. Luggage storage is provided on the lower level together with center entrance vestibule one step up from normal low station platforms. Lounge and toilet facilities are on this lower level and a crew room is also provided. This room is used by courier nurses and others of the train crew and in long trains some may be used for storage space when not required for crew.

The chair car provides its own diesel-generator auxiliary power as do the diners and lounge cars. These provide 220-volt a-c, 3-phase power to support the individual car. The chair cars do not have glass in the roof; therefore the air-conditioning load is a little less than the full-length dome lounge. A capacity of 16 tons is provided and air delivery is through overhead ducts, both upstairs and down.

The principal interior feature of this train is that, while passengers enter at low central vestibules, they may communicate through the train all on the upper level. Two chair cars per train (one at either end) are provided with single end stairways leading to normal floor level of the dormitory car or of conventional cars which may be connected at the end of the train if traffic should demand this. Plastic linings are used extensively on the interiors and molded plastic reinforced with fiberglas is used for all complex air ducts. Sound equipment is featured for radio, recorded music, and train announcements. Considerable attention is given

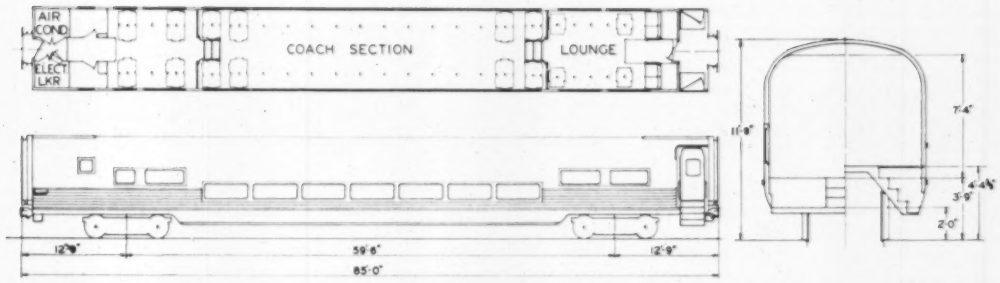

Fig. 5 Details of the Pennsylvania's depressed-center coach forming one unit of a new lightweight tubular train with head-end power

to lighting with various combinations of direct and indirect illumination, lighted panels and edge-lit decorated-glass partitions.

Two chair cars of this type were built and delivered about a year ago and run in revenue service to determine whether or not investment in this sort of equipment would be justified. This experience has been completely successful and has led Santa Fe to order equipment for six trains for transcontinental service.

Lightweight Coach

Fundamentally, this car is a refinement of the present lightweight coach, having a length of 85 ft, height 11 ft 9 in., capacity 88 passengers, lightweight 83,000 lb. It is directly comparable to a conventional coach of 86 passengers, weighing 115,000 to 130,000 lb (1300–1500 lb per passenger). With equivalent mechanical equipment, this car will weigh 83,000 lb resulting in a reduction from, say, 1500 lb per passenger to 940 lb per passenger. Where head-end auxiliary power and steam heat are available, the weight is further reduced to 75,000 lb at a weight per passenger of 850 lb with center of gravity at 47 in.

The accommodations are conventional for a coach. The seat spacing is $35^1/_2$ in., indicating an intermediate degree of luxury. Interior decorations could be anything desired, but preferably simple, consistent with a minimum cost per seat.

Lightweight Tubular Train

This coach for the Pennsylvania Railroad replaces conventional coaches intended for intermediate distance travel which are available at about the same capacity but at a weight of 115,000 to 130,000 lb in modern equipment and 145,000 lb in rebuilt heavy-weight equipment. The train under construction will consist of seven of these coaches, a head-end power car including a food-preparation center and conventional electric or diesel locomotive. This train, excluding locomotive, will weigh 1170 lb per passenger as compared to an equivalent train of modern passenger equipment at up to 1585 lb per passenger or heavy-weight equipment at 1770 lb per passenger. Seat spacing is $35^1/_2$ in. consistent with a high-capacity requirement. Expensive decorations will be avoided, but all modern techniques to give the feeling of luxury without a considerable increase in cost will be used. Details are given in Table 2 and Fig. 5.

The structure is designed to full AAR strength level consisting of conventional end-frame and side-frame construction. The under-frame is unusual in that no center sill is used.

The auxiliary power is supplied by a head-end power car providing two diesel alternators each capable of supplying 265 kw of 440-volt, 3-phase, a-c power.

Table 2 Particulars of Pennsylvania Lightweight Coach

	Coach	Head-end power
Type of car	Coach	
Length, ft	85	53
Height, ft-in.	11-9	11-9
Capacity	82	...
Seat spacing, in.	$35^1/_2$	...
Lightweight, lb	82000	97000
Center of gravity, in	42	50
Weight per passenger, lb	1000	...

Air-conditioning capacity of 8 tons is provided in each coach with equipment about normal except that it is powered with a-c motors. Electric heating is used to minimize the maintenance and steam losses occasioned by steam heat, although there is some increase in train weight and train cost because of this feature.

The principal feature of this car is the depressed floor between trucks which results in an attractive arrangement for a coach and one which can be utilized for other kinds of cars without undue restrictions. This feature permits the unusually low center of gravity of about 42 in. There is little weight sacrifice to provide this feature. A smoking lounge is provided at one end of each coach. A feature of the interior is the elimination of window curtains and the use of glass with graduated tinting to control glare.

High-Speed Self-Propelled Train

The high-speed self-propelled train for the New York, New Haven and Hartford Railroad (Fig. 6 and Table 3) is perhaps a logical development from the RDC (Fig. 7) which has been giving excellent performance in single-car or short-train consists, in both branch-line and main-line service. By redesigning the front and rear ends of the train to provide a more or less conventional locomotive cab at either end, the unit becomes more suitable for regular high-speed main-line operation. This train is intended for intermediate distance travel and would replace a 6-car train of conventional coaches and conventional locomotive. This train would weigh 1440 lb per passenger as compared to the conventional train at 2000 lb per passenger. This difference is more striking if the motive power in horsepower per ton is

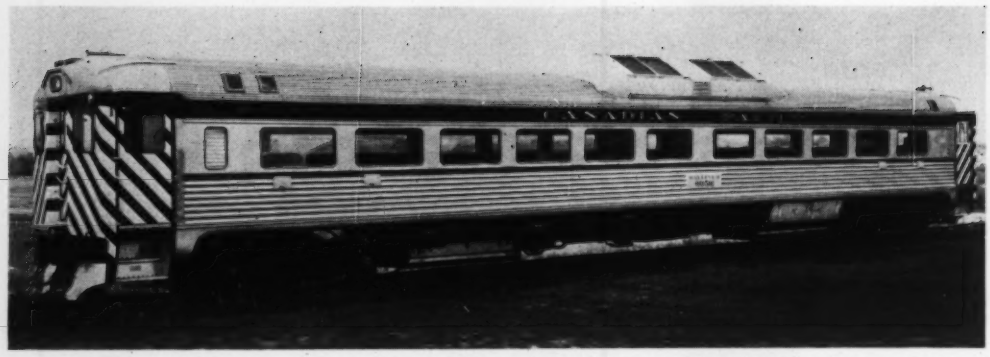

Fig. 6 Rail diesel car (RDC) served as the prototype for the development of New Haven's high-speed train

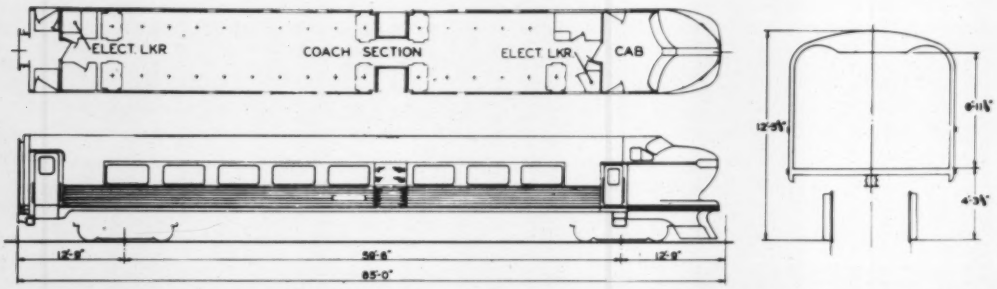

Fig. 7 Front-end unit of the New Haven Railroad's high-speed self-propelled train for use in main-line service

made more equal, in which case the conventional train would weigh 2700 lb per passenger. This train is intended for extreme high-speed performance including acceleration and deceleration. The self-propelled feature permits a minimum of weight of motive power per passenger which improves both acceleration and braking.

Eight tons of air conditioning are provided with compressor and condenser located under floor with conventional overhead evaporator, duct, and distribution. The heating, as in the case of the RDC, is provided by engine-jacket cooling water. Each car has two Detroit Diesel 6-110 diesel engines with Allison torque-converter transmissions exactly as the case of the RDC, although it should be noticed that the latest engines are now rated at 300 hp at 2000 rpm.

For operation in New York City tunnels and stations, one auxiliary electric truck-mounted traction motor is provided for each car.

Table 3 NYNH&H High-Speed Self-Propelled Train

	Intermediate car coach	Train 6 cars coach
Type of car		
Length, ft	85	510
Height, ft-in	12-5 3/8	12-5 3/8
Capacity	80	448
Seat spacing, in.	39 1/2	39 1/2
Lightweight (not incl. electric traction), lb	109500	658000
Center of gravity, in	51	51
Weight per passenger (incl. motive power), lb	1370	1470

Aside from its performance, the outstanding feature of this train is flexibility. It is double ended to avoid the need for turning. Any reasonable length of train can be made up without changing motive-power requirements.

This train concept naturally raises the question of operating cost with a multiplicity of engines. RDC operation has demonstrated considerable improvement over locomotive-drawn costs for short trains. This improvement diminishes as the train becomes longer, becoming equal at roughly a 4 or 5-car train where performance is not important. For equal performance, approximately measured by equal horsepower per ton, the advantage enjoyed by the self-propelled train holds for considerably longer trains and probably for all useful lengths.

Siesta Coach

The siesta coach (Figs. 8, 9, and 10) provides a new service—a new accommodation. It provides 40 passengers with enclosed lie-down sleeping accommodations. Present indications are that at standard coach fare plus perhaps a nominal extra charge, the car could be operated at a profit. On this basis, the fare would be considerably less than a section sleeper while the passenger has the conveniences of a roomette. The weight per bed at 3340 lb is considerably lighter than for a 16 open section sleeper at about 4250 lb.

The accommodations are upper and lower duplexed single rooms with a 24-in-wide berth and 4-in. thick foam-rubber mattress, together with double rooms which

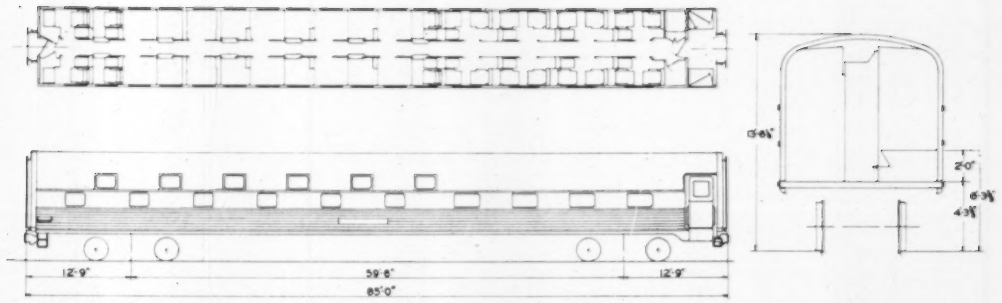

Fig. 8 A new service is available in the siesta coach, providing enclosed sleeping accommodations for 40 passengers

are more like an enclosed section sleeper. Toilet and washing facilities are provided in both room types and are available with berth up or down. Some flexibility is possible in the proportions of single versus double rooms.

Naturally, the accommodations are less spacious than a roomette. However, the reaction of a number of coach passengers to full-size samples indicated an enthusiastic reception. Forty passengers per car would be provided on the basis of 24 single and 8 double rooms.

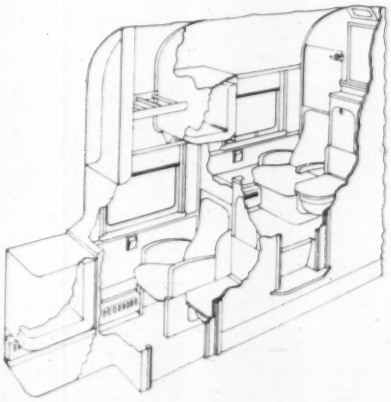

Fig. 9 Siesta coach rooms arranged for daytime occupancy

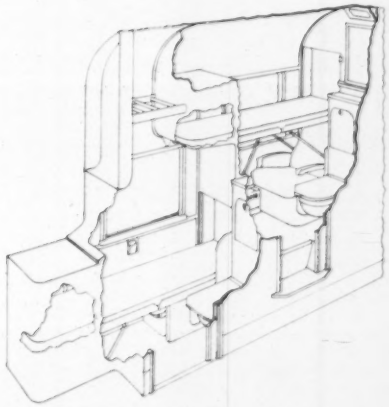

Fig. 10 Siesta coach rooms showing berths lowered for sleeping

The car structure and equipment are figured as standard Budd main-line practice, but the accommodation can be applied to the new cross sections under consideration with some modifications. The rooms are designed with rounded corners and sanitary coves to facilitate cleaning. Extensive use of colored plastic finished surfaces will minimize painting maintenance. Heating and cooling controls similar to first-class room accommodations are provided. One attractive feature to encourage travel is a crib for infants which can be installed readily in any single room.

It is felt that this accommodation will be most helpful to bridge the gap between the coach and the conventional sleeping car where it should find a large market among those passengers who are unable to sleep in their chair regardless of how comfortable it may be during the day and who are reluctant to pay the first-class plus Pullman fares.

Meeting Today's Competition

The author's company has concluded that no one train is best for all operating conditions. Luxurious and comfortable equipment will draw passengers on long hauls, and high-speed low-operating-cost equipment, conducive to lower fares, will certainly stimulate intermediate distance travel. For very high-performance equipment, the motor train has much to offer. Where moderately high-speed long trains are suitable, the highly economical locomotive-drawn coaches will give minimum operating costs. For converting losses to a profit or at least reducing existing losses on short hauls, the brilliantly organized RDC operation of the Boston & Maine Railroad, for example, or the high-capacity suburban gallery cars recently placed in service by the Chicago, Burlington & Quincy and others, appear to be solid contributions. The siesta coach should give considerable impetus to overnight coach travel.

It is believed that successful equipment of an improved type is needed *now*. The possibilities of increased efficiency in novel rearrangement of the customary 85-ft car with 4-wheel trucks are far from exhausted. The cars described in this paper compare favorably with the radical approaches presently under consideration, and this is accomplished for a variety of operating conditions without radical changes to proved components of equipment, structure, and furnishings.

Author's Note: Development of the high-speed self-propelled train for the New Haven Railroad since the original preparation of this paper has brought about certain changes which for the sake of accuracy should be recorded here. The exterior appearance has been changed principally in the return of the radiators to the roof like the RDC installation, and in a revised design of the locomotive-type front and rear ends. Inside the capacity has been reduced to 60 in the lead units and 76 in the intermediate cars. This was done principally to eliminate bulkhead seats. To improve electrical performance there are now two traction motors per car instead of one. There has been no significant change in weight but the new total capacity reduction from 448 to 424 will make a correspondinge change in weight per passenger.

Electronic Computers Solving Production-Engineering Problems

By Charles R. De Carlo

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During the past several years, considerable interest has been centered upon the possible use of the electronic automatic digital computer as an instrument in production management. Although in practically all cases the machines were originally installed for engineering and scientific calculations, production managements were soon to realize the possible benefit that might accrue from using such a device in the solution of complex production problems. Most of the large computers procured to date by industry, aside from those to be used in large paper-handling applications, such as life-insurance premium notices, public-utility billing, and integrated accounting operations, are to be used in solving problems affecting real production, inventory, and distribution operations.

THERE are many reasons for adopting electronic automatic digital computers to help solve problems in production, inventory, and other industrial operations. Perhaps they can be summed up in the statement that there are several areas of dissatisfaction in production and inventory management which thus far have defied the efforts of man to exercise rational control over them. The electronic computer, with its dramatically demonstrated ability to perform complex mathematical computations and to solve exceedingly profound physical problems, has generated a great hope in production management for its use in this area.

What the Electronic Computer Can Do

This interest in electronic computers on the part of production management is not an unrealistic interest, for production and inventory management are beset with complex problems which involve abilities inherent in the large electronic computer. These abilities are:

Ability to Handle Large Volumes of Information. Certainly the information required to describe manufacturing processes, record production, publish schedules, maintain piecework rate tables, manufacturing specifications, and so on, implies the need for extremely high reading and writing speeds. The computer of today, reading and writing at better than a million characters per minute, can scan and publish enough information to describe properly even the largest production or supply system.

Contributed by the Production Engineering and Metals Engineering Divisions and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 55—A-161.

Ability to Handle Many Variables Simultaneously. The major characteristic of production and inventory problems is the appearance of hundreds, even thousands, of variables, each interdependent and necessary. There are examples of a typical cost equation for one product, representing a combination of yields and process costs, which require several printed pages. These equations represent the fact that each section of the process is itself a variable and must be entered accordingly. When these variables are combined with those describing inventory and market or forecast, the total number of variables can become enormous, as in typical scheduling problems.

Ability to Perform High-Speed Arithmetic Operations. In computers, as they are manufactured today, additions and subtractions can be performed at the rate of 250,000 to over 1,000,000 per minute, depending on the type of data-processing system. Multiplication times on these machines can vary 50,000 to 240,000 per minute. These speeds are necessary if production problems are to be attacked analytically. For example, in the simplex solution of linear programming, calculations involving the eliminational algorithm occur repeatedly. This algorithm, commonly used in solving linear systems, involves a multiplication, division, and subtraction and must be repeated a number of times approximately equal to the third power of the size of the system. For a thousand equations, this represents several billion operations.

In addition to the great number of calculations in solving even simple, but large, linear systems, high-speed arithmetic is also a necessity in the solution of complex mathematical problems. Such complex mathematical formulations, particularly differential equations, must become a real part of production and inventory management. To date most problems in these fields have been considered, from an analytical point of view, as static, or "steady-state phenomena."

Ability to Perform Logical Choices. Computers, as they are organized today, can perform logical decisions from 500,000 to more than a million per minute. These logical decisions generally rest on arithmetic abilities of discerning the greater or lesser of two particular numbers or characters. Such logical choice and the speed of choice are necessary for the computer to follow complex procedures. In using the computer it is necessary to define the logical requirements or procedure into a primary set of operations which exists within the computer. Thus in one large centralized inventory-control system it is necessary to specify almost 60,000 separate instructions. Some of these instructions will be executed for each accounting entry describing a particular commodity or transaction. When one considers the number of instructions, the number of items

reported and handled daily in such a system, the value of this particular ability can be appreciated.

Ability to Enumerate a Large Set of Possible Actions. Most scheduling operations are combinatorial in nature. Thus, to schedule a set of products through a group of operations is equivalent to selecting a combination whose elements are the amount of time spent of any one product on any one machine, with certain combinations not allowed because of precedence relationships in processing. Now, if for each combination, i.e., detail schedule, one can associate a function such as a typical cost function, the problem becomes one of selecting that combination which will give, for example, minimum total cost. In this case the cost might be summed over all the products and operations. However, in even simple idealized cases, and assuming the fastest machine available, it would be impossible to enumerate completely all possible combinations in cost. Thus there is a need to develop a mathematics which can short-cut the enumeration problem.

Combinatorial mathematics to date is a new field, probably for the principal reason that until the advent of the electronic computer the mathematician has had no laboratory in which to test his combinatorial theories. However, in real life, production and inventory problems and their combinatorial nature will dictate that both mathematics and machines be improved to handle this important phase.

In addition to pure combinatorial enumeration, the enumerations also can be considered where answers are being provided to analytic problems. Thus, for example, in solving a typical problem of allocating machine capacities against a set of orders, the computer actually can list the possible choices of product mix. Thus, assuming that a mathematical device such as linear programming is used, the various choices can be listed and the associated function to be minimized observed. Certainly the heart of decision-making in any form is acquiring data, digesting and processing it, enumerating choices against a set of criteria and choosing the one that best meets that set. In this sense, the computer will enhance management's intuition by broadening the scope against which choice can be made.

Ability to Operate in Stochastic Processes. In all problems involving the real world there are elements of variability. Thus the detail scheduling of a shop is contingent upon various time and operational standards established for the shop. The actual completion of work through the shop will depend upon the probability of breakdown, delays, lack of material, and so on. Through use of modern probability methods, considerable strides can be made in simulating the real world via a computer. The computer has the ability to evaluate probability distributions, store density functions, generate random numbers for entry into such tables, and to compute by repeated trial the expected value of a variable phenomenon or a sum of variable phenomena.

Computers in Many Fields

Production Scheduling and Control of Shop Orders. Probably one of the most complex production applications being done on an electronic computer occurs in the aircraft industry where the IBM Type 701 is used for production scheduling and control of shop orders. In this instance, after a contract is procured, a master schedule is established stating the number of ships, rates of production, and number of days a given rate is to be effective. The Type 701 prepares a "base schedule" which shows, by shop calendar date, the exact-day each ship is due at a given station or line position on the production line. This schedule may be revised as manufacturing schedules accelerate or retard. Following the computation of the base schedules, ships of a given contract are grouped into lots for manufacturing. Thereafter all fabrication and assembly parts are scheduled to the first ship of the lot.

All information pertaining to the schedule, engineering description, spares' requirements, cost, and so on, is written as one main tape file. A file is prepared weekly reflecting all changes in the main parts and schedule file. This file contains engineering and manufacturing changes as well as inventory information.

This change file is processed with the main tape file and a completely new revised main tape file is written. Calculations are made during this processing. Engineering and manufacturing changes are entered in the main file. Part usage by assembly and plane is extended and summarized by lot and contracts. Net quantities are computed for each lot in each contract. Previous part orders are examined and if a need for a part is determined it will be scheduled and written on an output tape, to prepare a shop order later. A scheduling operation is performed and the need for part orders on succeeding lots is determined. The machine will continue to schedule quantities for each lot until a lot is reached which does not require the present initiation of shop orders. Finally, orders are written for those parts which require replacement.

Perhaps the most important concept illustrated by this use of the Type 701 lies in the consolidation of many files (all basically related to the part number) into one file. The weekly processing of this file against one change file representative of all types of changes creates a variety of output data and automatically revises the main file to current status. Thus engineering, manufacturing, inventory and planning information are all treated simultaneously for better management.

Evaluating Work Standards. One company is currently using statistical methods to evaluate the work standards in a job-shop fabrication unit. In this application, time data are gathered in the normal fashion and then subjected to statistical analysis to determine the importance of several production variables. Using the computer to perform the statistical calculations, final equations are developed for each hypothesis concerning the production variables. Prior to this, the data are examined by the computer for consistency about trend lines and in some cases the computer actually plots the distribution of the data. Having the equations relating the production variables, rate tables may be made which correspond to each particular hypothesis. The equations are evaluated for all ranges of production and the results compared with the actual data for closeness of fit. After the best standard is selected, it is possible to use the equations to determine the expected output of the workers in a particular plant. This can be done in the normal mathematical computation of expectation, where past data are analyzed by class of production variables, with the associated probability of production falling within a particular class. The rates for each class are then applied to the probability distribution by class and summed, such a sum representing expected production.

What has been accomplished to date gives promise of a bright future for the use of the electronic automatic computer in production engineering. In common with the use of the electronic computer will be the development of mathematical and scientific methods in production engineering. It is to be hoped that universities will increase the already strong interest in the problems of production management and management science. Certainly the industrial-engineering departments and the mechanical-engineering departments of most of the major universities have, or will undertake, the teaching of applied mathematics as an engineering tool. Without the precision that is implied in the mathematical treatment of a problem, solutions of complex production and inventory problems would be hopeless indeed, even in the presence of the largest and most powerful computer man will ever be able to build.

Measuring Production. The importance of using statistical methods in establishing productivity measurement lies principally in the better control the production engineer gains, as well as allowing for better prediction in scheduling labor and shop facilities. Generally, the production and industrial engineer has made little use of statistical and probability methods in his work. One of the reasons for this is the tediousness of the calculations necessary to establish statistical relationships. In this instance the electronic computer adds a really new and powerful tool to the production engineers' work.

Use of Mathematical Models

Monte Carlo Techniques. As management attempts to refine control of its production and inventories, it must take into account the variability of the real world. Mathematical models have been constructed which involve the use of stochastic variables. An interesting example of these probability methods, commonly referred to as "Monte Carlo" techniques, has been studied by one of the large petrochemical organizations. In this particular problem long and expensive shipping lines exist between the producing units and the market where the products are to be sold. Raw material is periodically shipped into the producing unit and inventories held at the unit in order to allow producing and inventory operations to meet market demand. In essence, the problem was to determine the amount of raw material needed at the producing unit to control inventory fluctuations, at the same time assuring a reasonably constant rate of shipment from the producing unit to market demand.

A mathematical model was built paralleling the flow of material from the raw state, through processing, inventory, and shipping, to the market. At each point variability was introduced through the use of frequency distributions based upon past experience. For example, variation in shipping time was entered as part of the model. Also, the variation associated with the normal running time of the batch-type operation, as well as variations in the production setup times, were included.

Having built a mathematical logical model in which variability was treated, it is possible to study the expected operation under a wide variety of production conditions. More than this, various inventory control limits could be set and, as a result of these, expected production figures could be obtained. In addition to studying the relationship of inventory fluctuation and controls in production practices, this application is important in that it demonstrates that the variability inherent in all real operations can be included as part of the calculations of a production-control operation. Particularly, a large-scale electronic computer is an ideal instrument for this purpose since it can rapidly generate the random numbers required in Monte Carlo techniques as part of the procedure itself.

The Transportation Model. A particular mathematical method which is finding increasing use in production and inventory management is the transportation model. This is a specialization of the linear programming problem. The essence of this problem is the following: It is desired to transport an item from several dispersed sources, each with a given supply, to numerous dispersed destinations, each with a specified demand. Shipping costs from any one source to any one destination are known. It is desired to determine what amounts should be shipped from each source and to each destination in order to satisfy all market demands with minimum over-all transportation costs. One company operating several plants, with a great number of warehouses dispersed throughout the United States for further distribution, had a capacity excess in the western part of the country and a demand excess in the east. Because of this, considerable tonnages were shipped from western plants to eastern warehouses so that the cheapest distribution costs could not be achieved by simply shipping from each plant to the nearest warehouse. In this case, using the transportation model, a distribution was found which achieved a savings of many thousands of dollars.

Learning-Curve Theory. A new tool which is finding increasing usage among production engineers in various industries is the learning-curve theory as developed by the aircraft industry in World War II. This theory is based on the idea that as a worker or a group of workers repeats a series of operations in production they learn to become more efficient, thus decreasing the labor required for successive units. Basically, it states that the labor required for successive units in production will reduce in such a way that the accumulative average of the hours will be reduced by a constant percentage as the number of units is doubled. This concept has been well established and used in the aircraft industry. Through the use of the learning curve it is possible to predict the hours required for future production schedules.

A further use of the computer in the aircraft industry is the development of learning curves and production-acceleration curves. This is a mathematical application based upon the methods of statistics and curve fitting ideally suited to the electronic computer. One important feature of the computer in its use lies in the fact that it will enable a company to evaluate and re-evaluate the learning curve and acceleration formula continuously, in the interest of better production control.

Relating Materials-Handling Costs to Over-All Production Costs . . .

. . . *Some Basic Concepts*

By B. W. Saunders, Member ASME

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For many years materials-handling costs have generally been lumped with other overhead costs and as a result have lost their identity. Recently, however, materials-handling costs have been receiving more attention from both engineers and managers. As a result, certain problems have arisen, and discussion of these problems is essential to clarify the type of factual data which must be available. The problems are in three broad categories.

Three Functions Involved

Consider the designer who must design a handling method or device to accomplish a given purpose within certain restrictions. He needs costs and procedures for evaluation of alternatives. Then there is the production planner who must schedule and dispatch materials utilizing available handling devices to the available production machines under varying conditions of quantity, quality, and time. He also needs costs and procedures. Finally there is the manager who is responsible for the control of handling costs. He needs a bench mark or standard of comparison to be able to deal in relative terms.

It is important to understand these different positions. The design responsibility requires that a system be specified and built to accomplish a given result within certain fixed limits. In this process alternatives are going to be developed. Selection of one over the others, assuming all meet technical requirements, will be based largely on cost studies resulting from some evaluative procedure. The question then arises as to what costs and what procedures should be used. The production planner, on the other hand, has a dynamic situation with many variables.

What is correct or optimal today may not be tomorrow even if the same criteria are used in making the evaluation. Internal conditions of machine loads, inventory conditions, and available capital all change and will give different answers at different times even to the same problems. The manager who is concerned lest costs be too high must have in mind both a procedure and cost data that can evaluate the dynamic conditions suggested. Therefore, when considering the problem of materials-handling costs the differences that exist must be kept constantly in mind.

On the one hand there is the design situation to specify and build a system to accomplish a given result within certain fixed limits. On the other, with a set of available facilities there is the constant re-evaluation under operating conditions to achieve optimum performance with the available facilities. These two basic concepts are the important ones to be kept clearly in mind in order to make proper evaluations and judgments concerning materials-handling costs. Before examining these concepts any further a brief look at the accounting procedure would seem to be called for.

The Accounting Problem

The accountant is concerned primarily with the functions of recording and reporting costs as they occur, liquidating those costs over the various products, preparing financial reports, and periodically doing some interpretive work. The traditioual classification of manufacturing cost into direct material, direct labor, or overhead has not changed appreciably for many years. Today with more and more mechanization and less and less truly direct labor, the policy of clinging to older concepts of measurement and evaluation of product in terms of direct labor content seems questionable.

A large part of manufacturing labor is not direct if we define direct labor as that labor which is used to transform by the application of skill a material from one form, state, or position, to another. The labor in many cases that is classified direct by custom is nothing more than the labor of a machine attendant. The skill is in the machine. The operator merely operates the machine.

In the handling operation there are also operators. They are treated as indirect laborers rather than direct. The basis of classification which results in this differentiation between these two types of operators does not seem to be a logical one in view of the definition of direct labor mentioned. Both the loading of the machine tool as well as the loading of an industrial truck or conveyer has to be done. Why then should they be accounted for according to different degrees and standards of measurement and accuracy? The question is answered by saying—it is the cost of cost accounting. One can then question whether the saving in cost accounting is greater than the expense of uncontrolled handling costs that have not been isolated and identified.

It would appear that cost accountants should review their procedures with the objective that machine costs are properly analyzed for all types of machines, labor costs for all types of labor, material costs for all types of material. Within economic limitations, all direct variable costs should be related to some product or process so that the direct costs of production can be related properly to a realistic base regardless of where they may occur. This means that all machine costs which are variable should be determined and that standards should be available for the cost of operating that machine per

Contributed by the Materials Handling Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 55—A-170.

hour of operation. Labor standards are frequently available in terms of man-hours per piece, so by utilizing the labor rate a simple extension would give the labor cost per piece. This idea of standards would have to be extended to the machine, however, and a standard rate for the various products on the machine would have to be established. This would mean a standard expressed as

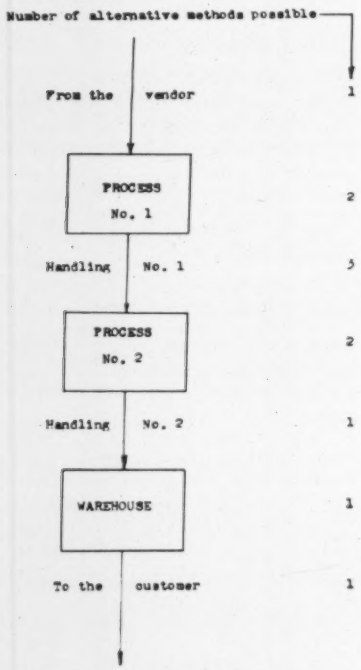

Fig. 1 Suggested production system

"machine hours per piece" to parallel the standard "man-hours per piece."

Concept of Direct Costing. With this information and the standard rate for the machine given in dollars per machine hour, a simple extension would give the machine cost per unit of production. The cost classifications would then be direct material, direct labor, direct machine, and direct variable overhead costs. This concept is merely the adaptation of the concept of direct costing, which treats investment costs of equipment as a "sunk cost" along with other fixed costs.

Designing an Integrated System

With this thought in mind, let us return to the problems previously suggested. The first was the design problem. It would call for a specification for a materials-handling device or method to operate within a given range of production. Coupled with this problem may be the parallel design of other elements of the production system. If not, then the device or method must at least be integrated with other elements of the system. Thus it becomes apparent that the engineer is not free to design or create in terms of the handling problem alone. He must consider what has come before and what is going to occur after the handling has been accomplished. This suggests that the design of handling devices and methods, even though they may occur independently, nevertheless must be done as part of a system involving other handling elements, processing, and storage elements.

The engineer must think and deal with the total system of production and not with individual elements alone. How is this broadened concept utilized in design work? It means that the total problem of receiving material in some form and getting it into some other form, including all material, processing, and storage devices, must be considered as a whole rather than treating individual elements. Then sufficient information must be provided to the accounting or cost-control group to control and evaluate the system properly rather than to allow it to be evaluated by some arbitrary and perhaps false standards.

Production Planning. In Fig. 1 is a suggested production system. This can represent either a "job" shop or it could represent a "product" shop including some of the current concepts of automation. When the engineer has been faced with the design of elements for such a system, frequently he has taken each step singly, determined what he wanted to do, how he would do it, and then what he

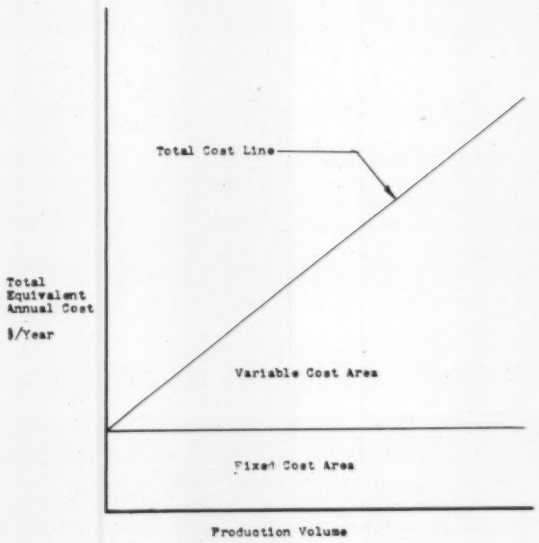

Fig. 2 Total cost diagram which may be applied to any method

would do it with. In the case of processing, this meant determination of the process itself, then the sequence of operations within the process, and finally the selection of a machine to accomplish the result. In the case of handling, it meant determination of the technique of handling; i.e., unitizing, conveyerization, and so on, then as before the sequence of operations to accomplish the technique, and finally, the selection of the proper machines and equipment.

The determination of the techniques and the specification of the sequence of operations is based on engineering analysis of available facts. The selection of equipment presumably was made by looking at possible alternatives and evaluating them in terms of their relative costs with each other. As a result, the cheaper equipment, other things being equal, would be chosen or speci-

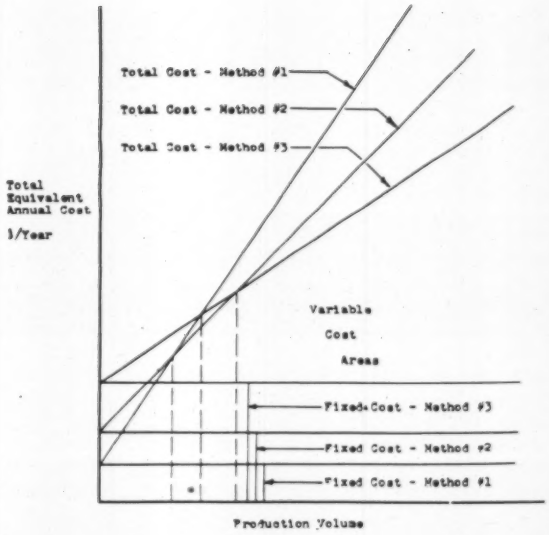
Total Cost - Method #1
Total Cost - Method #2
Total Cost - Method #3
Total Equivalent Annual Cost $/Year
Variable Cost Areas
Fixed Cost - Method #3
Fixed Cost - Method #2
Fixed Cost - Method #1
Production Volume

Fig. 3 Total cost diagram showing relative costs of alternative methods

fied. The real problem, however, is not merely to evaluate competing methods or equipments with each other, but to evaluate them in terms of their contribution to the system as a whole. Then, on the basis of the evaluation of the total system, a judgment and specification can be made.

A Doubtful Approach

In a paper by J. A. Shepard and G. E. Hagemann[1] presented before the Society on May 20, 1925, certain proposals were made showing how various alternatives could be evaluated with each other. These formulas were accepted and have become recommended procedure with the endorsement of the Society. They have been printed in textbooks and handbooks with the ASME recommendation as late as 1954.

The author has serious doubts and reservations concerning these formulas and their ASME endorsement: (1) One cannot agree with the formulas as they are given and currently being used. Our ideas and information have changed in 30 years: (2) More important is the rejection of the idea that individual elements of the system should be measured independently of the system as a whole. Many writers are still saying that one should select equipment for the lowest over-all handling cost. It is possible that the lowest over-all handling cost can yield the lowest over-all production cost but this is no certainty. In spite of this, most modern textbooks in the field still emphasize this "lowest materials-handling-cost concept" as opposed to "lowest production-cost concept."

How Not to Select Equipment. Referring to Fig. 1, consider the problem of selecting equipment for the handling operation between Processes 1 and 2. Assume there are three possible methods or pieces of equipment that will satisfy the conditions. If one were to take one method and plot the values of fixed cost including the costs of capital recovery, interest on the investment, taxes, insurance, and so on, one would get a horizontal line using "production volume" as the abscissa and "total equivalent annual cost" as the ordinate. By adding the variable costs associated with the same method the total cost would show as an inclined line with a positive slope. The whole graph would appear as in Fig. 2. A similar type of graph could be made of the other methods and when superimposed on one another they would appear as in Fig. 3.

Series-Analyses. This makes possible a comparison of the three methods with each other which it has been pointed out is inadequate. In no case has anything been included that would show how costs might vary if the processes that precede and succeed the specific handling operations were included. To show the magnitude of the problem facing the engineer even with this simple example, there is shown in Fig. 4 the possible combinations that should be evaluated. It is possible that in a more complex example where more than two processing steps are required, and further, where certain precedence relationships are not rigid, various permutations also would have to be evaluated where they are feasible. What is needed then to be more realistic in the evaluation would be a series of analyses that would show curves for each combination, superimposed on each other in order to find at what point and at what production volume the best performance from a cost standpoint could be expected.

Process #1 has two alternatives P-1a, P-1b

Handling #1 has three alternatives H-1a, H-1b, H-1c

Process #2 has two alternatives P-2a, P-2b

Possible Combinations

Process #1		Handling #1			Process #2	
a	b	a	b	c	a	b
x		x			x	
x			x		x	
x				x	x	
x		x				x
x			x			x
x				x		x
	x	x			x	
	x		x		x	
	x			x	x	
	x	x				x
	x		x			x
	x			x		x

Fig. 4 Possible combinations to be considered in analyzing over-all production costs

One criticism logically made of such an evaluation is the assumption that all units are to be made with one setup or in one lot. This is not often the case. If the abscissa were changed to "number of lots" and the ordinate to "unit cost of product," and if a fixed output per year were assumed, then the fixed costs as before will remain fixed even on a unit basis because only one gross output level per year is considered. The variable

[1] "Formulas for Computing the Economics of Labor-Saving Equipment," by J. A. Shepard and G. E. Hagemann.

costs of material and labor on a unit basis also will plot as a straight line.

However, another factor is now considered that will increase with the number of lots. This is the cost of starting up each lot, the cost of setup, of production control, of spoilage, and the like, which occur with every change-over or start-up from an idle position. Also, as

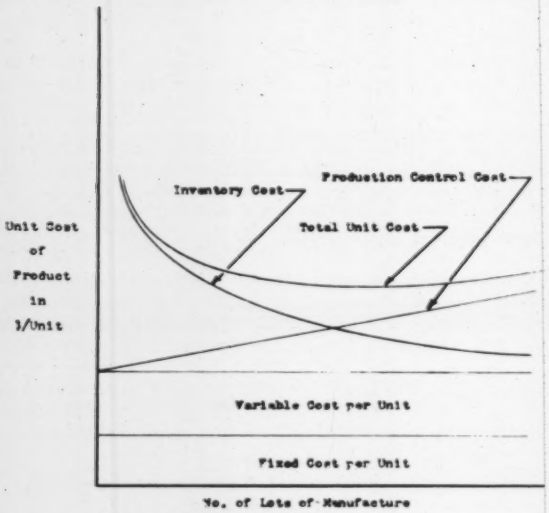

Fig. 5 Cost diagram showing unit costs for a single method and assuming a fixed output

the number of lots increases, those charges generally associated with inventory will be decreasing on a unit basis. These two factors along with other previously identified costs can be put on another curve shown in Fig. 5. Now, however, there will be different set-up costs and different production-control costs depending on the different types and combinations of equipment that are recommended so there will be a new total cost curve for each permutation and combination of possible solutions to the design problem. This is nothing more than the well-known problem of determination of "economic lot size." What is new is the notion that economic lot size should be considered at the time of equipment selection and specification along with the broader concept of over-all production costs rather than individual process costs.

Materials Handling a Part of Production

The important thing here is not the methodology of determination, but rather the concept of what must be looked at and included in the evaluation. This paper is concerned with concepts and not solutions. The important concept here is one involving the notion that materials-handling costs are related to, and cannot be divorced from, other production costs even at the design stage of a particular problem. The evaluation must include the system as a whole of which the handling portion is but a part. Perhaps some of the concepts of mathematical programming that deal with nonlinear situations can be applied to design problems. Whatever methodology does emerge will come only after further study and research on the problem of production design and the relationship between the many factors involved.

As a Process Cost. The second basic concept which was identified earlier relating materials-handling costs to over-all production costs was that classifying the materials-handling costs as another process cost. As such they should be evaluated in the dynamic situation of the day-to-day changes in business activity, schedules and routings, the issuance of production orders which specify both time and quantity, and similar types of operational duties. One of production-planning's major jobs is to see that the available equipment and facilities are used in an optimal manner based on the conditions that exist at the time the production orders are issued.

Linear Programming. This leads to the notion that under one set of conditions, for a given product to be processed in an optimal manner, one routing using one set of equipment may be specified. For the same size order, for the same product, but at a different time, a different routing utilizing different facilities may be optimal because of the different conditions that exist at the time the second routing is to be made. This suggests the technique of linear programming. If the relationships are linear, i.e., if cost data are used based on variable or marginal costs as previously discussed, and if other parameters of the situation are likewise linear in characteristics, then linear programming might be used if the essential conditions that such programming techniques require are fulfilled.

If these conditions are fulfilled, and if materials-handling costs can be likened to productive operations and given similar unit rates, then the resulting situation is quite comparable to those already reported in the literature but which have dealt with optimal use of machine tools. Where certain machine loadings have been stipulated and hence limited time on the equipment to perform certain required operations, linear programming has been used as a technique to solve such problems. The technique can be extended to the solution of materials-handling problems involving the use or allocation of equipment having certain hours and loadings already assigned to it. This problem has been covered in the literature[2] and no attempt is made to show by example how this can be done.

It is felt that handling costs can be isolated from overhead and unit handling rates and standards can be established for both machines and methods. The evaluation of alternative designs of production systems should be done on a system basis and not by consideration of individual units divorced from the system as a whole. This cannot be done with the present methods advocated by the Society, and hence would call for a revision of the material presented and approved in 1925.[1]

A Dynamic Approach Needed. Materials-handling situations are dynamic. Effective utilization of equipment and efficient operations can justify varying operating conditions because of changing circumstances. It is insufficient to say that materials-handling costs are too high unless there is full knowledge of the alternatives that were available prior to the time the costs were incurred. It appears that these are the important concepts that materials-handling engineers should keep in mind and strive to implement and improve.

[2] "Linear Programming," by R. O. Ferguson, *American Machinist*, April 11, 1955. "The Application of Linear Programming to Production Engineering and Scheduling," by E. L. Arnoff, ASME Paper No. 54—A-223.

Application of Superheated-Vapor Atmospheres to Drying

Process now commercially feasible; improved equipment becoming available at lower cost

By A. M. Lane[1] and Stuart Stern[2]

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THE unique advantages of using superheated vapors, especially superheated steam, as a drying medium have long been recognized; however, early attempts at commercial application were hampered by unavailability of equipment suitable for superheated-vapor operation. Much of the first drying equipment operated batchwise. Batchwise operation is inherently unsatisfactory for superheated-vapor drying because of start-up and shutdown losses. Much of the superheated-vapor drying was carried out under pressure, and equipment costs were thereby increased. As a consequence, superheated-vapor drying did not gain wide acceptance.

Until comparatively recently, no attempt was made to study the superheated-vapor drying operation and to obtain fundamental heat-transfer rate data which would be useful for the systematic development and design of such drying systems. Wenzel and White[3] presented experimental data on heat-transfer and evaporation rates for superheated steam at several pressures. Chu, Lane, and Conklin[4] presented similar data for steam, n-butanol, and benzene at atmospheric pressure. At the present time additional studies are being made and pilot-plant equipment is in operation. Production-size equipment is being planned. A typical superheater-vapor drier arrangement is shown in Fig. 1.

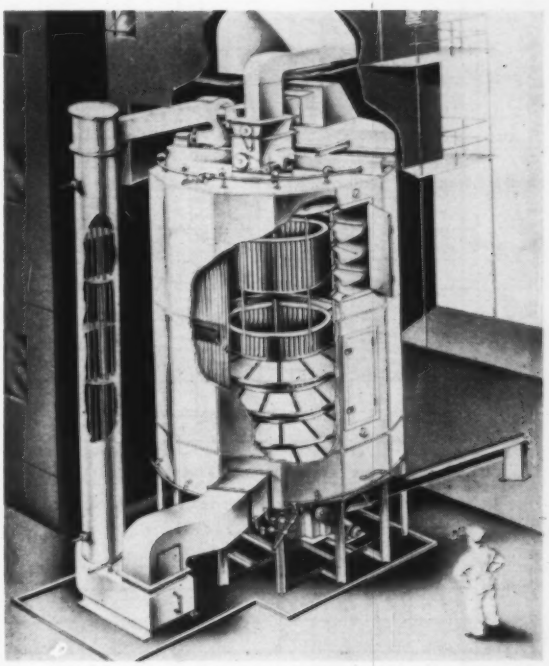

Fig. 1 View of typical superheated-vapor drier arrangement

Theory

The most obvious advantage of the superheated vapor-drying operation is its heat economy compared with ordinary air drying. In air drying, the evaporated moisture and air mixture leave the drier at the same temperature and each represents a definite quantity of heat. In an ideal superheated-vapor operation, only the evaporated moisture leaves the drier. Therefore, the heat represented by the air is not required and a net reduction and saving in heat requirement are achieved.

Fig. 2 shows the theoretical heat consumption by adiabatic air drying of water. Plotted on the same chart is the theoretical heat consumption when drying with superheated-steam vapor. The heat-consumption advantage is readily apparent. Fig. 3 shows the theoretical heat consumption for a nonadiabatic air drier in which the air is reheated to improve the thermal efficiency. Plotted on the same chart is the theoretical heat consumption when drying with superheated-steam vapor.

Fig. 4 shows the heat consumption when evaporating benzene both in an air drier and in a drier using superheated-benzene vapor. The chart shows the marked reduction in heat consumption by using superheated-benzene vapor.

Superheated-vapor operation also has the advantage over air drying that increased coefficients of heat transfer are obtained. This has been shown by Wenzel and White[3] and by Chu, Lane, and Conklin.[4] In superheated-vapor drying the inert-gas film resistance to heat transfer is eliminated and thereby heat-transfer coefficients are increased. Increased heat-transfer coefficients for superheated-vapor operation generally mean that smaller drying equipment can be used.

[1] Chief Engineer. Assoc. Mem. ASME.

[2] Chemical Engineer.

Contributed by the Process Industries Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 55—A-215.

[3] "Drying Granular Solids in Superheated Steam," by L. Wenzel and R. R. White, Industrial & Engineering Chemistry, vol. 43, 1951, p. 1829.

[4] "Evaporation of Liquids Into Their Superheated Vapors," by J. C. Chu, A. M. Lane, and D. Conklin, Industrial & Engineering Chemistry, vol. 45, 1953, p. 1586.

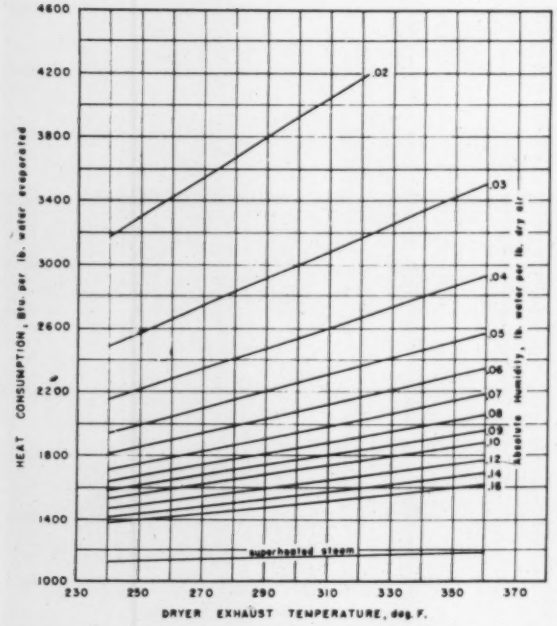

Fig. 2 Heat consumption for superheated-steam drying and adiabatic air drying

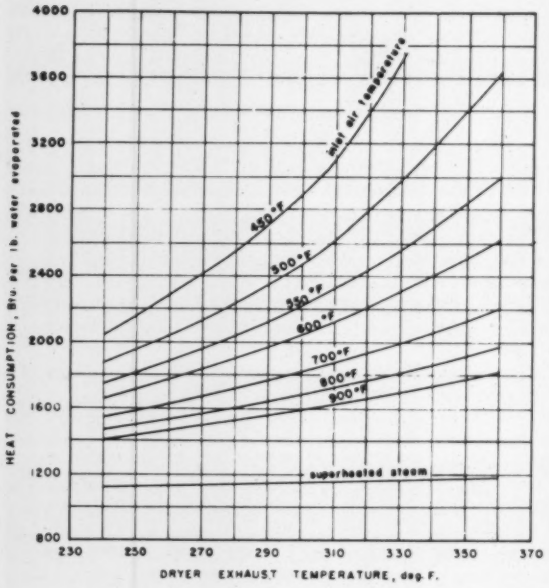

Fig. 3 Heat consumption for superheated-steam drying and isothermal air drying

Fig. 5 shows the rate of air-water drying and superheated-steam drying. Fig. 6 shows the same data for benzene evaporation. It is readily apparent that, except for operating temperatures near the saturation temperature, the rate of drying for superheated-vapor operation exceeds that for air drying. Drying ceases for superheated-vapor operation when the temperature of the vapor is at the boiling point of the liquid. In an air-drying operation, drying will cease when the air becomes saturated with the vapor.

This imposes a limitation on the applicability of drying temperature-sensitive products with superheated vapors. It therefore follows that superheated-vapor drying is applicable only for materials which have a temperature limit above the boiling point of the liquid being evaporated.

What Are the Advantages?

Aside from the advantages already discussed such as greater heat economy and reduced size for drying equipment owing to higher drying rates, there are several advantages which can be ascribed to the absence of air or oxygen from the drying system. Materials which are ordinarily oxygen-sensitive when dried in air at elevated temperatures can be dried successfully by employing an atmosphere of superheated vapor. Where it is necessary to remove an organic solvent from the solid being dried, very careful consideration must be given to the explosion hazard. Drying in an atmosphere of the superheated-solvent vapor eliminates air from the system and is, therefore, one of the ways in which the explosion hazard can be eliminated.

In ordinary air-drying installations the ever-present problem of dust losses and resulting atmospheric pollution has been causing increased concern. In most types of continuous driers, the material is either tumbled through the air stream or the air is passed through the bed of material. Large quantities of air traveling through the material at high velocity can create a significant dust problem. Recourse usually must be made to expensive and very often troublesome dust-collection equipment. There also may exist the problem of the dust-explosion hazard.

However, in superheated-vapor drying the only gases leaving the drier are the vapors generated from the moisture in the material. This reduced flow is in itself enough to keep dust carry-over with the vapor exhaust so small that superheated vapor can be vented to the atmosphere without fear of atmospheric pollution. When no atmospheric pollution can be tolerated the exhaust vapors can be sent to a total condenser where the small amount of dust is collected with the condensate and filtered out for recovery, if desired.

Condensation of the vapors offers the obvious advantage of being able to recover completely the moisture evaporated during the drying, whether the moisture is a valuable solvent or just water in a water-shy area.

Schemes of Operation

References in the literature[5] have been made to driers employing superheated vapors where recovery of the vapor was of prime importance. In the case where wool or leather has been degreased with naphtha, it was found most convenient to circulate a current of superheated naphtha vapor through the material. The liquid naphtha is vaporized and carried out of the drier to a condenser leaving the dried material practically free of naphtha.

It also has been proposed that superheated vapors be

[5] "Principles of Chemical Engineering," by W. H. Walker, W. K. Lewis, W. H. McAdams, and E. R. Gilliland, third edition, McGraw-Hill Book Company, Inc., New York, N. Y., p. 635.

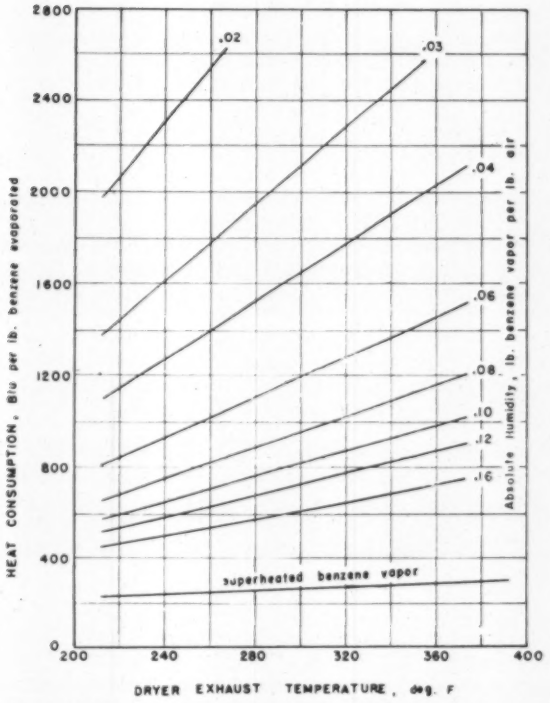

Fig. 4 Heat consumption for superheated-benzene drying and for air drying

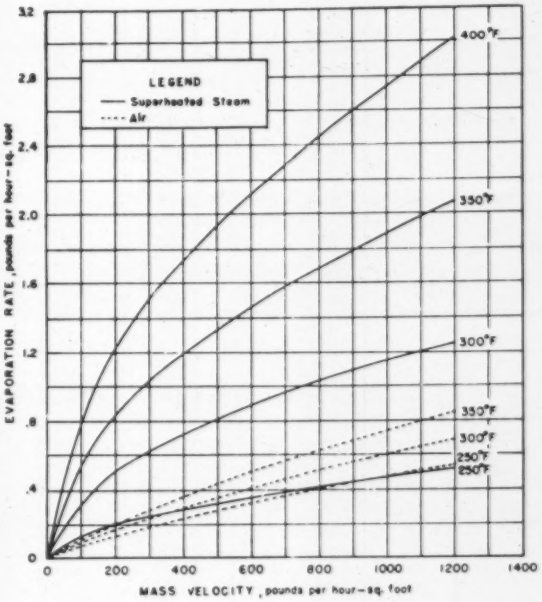

Fig. 5 Rates of evaporation of water into superheated steam and into air

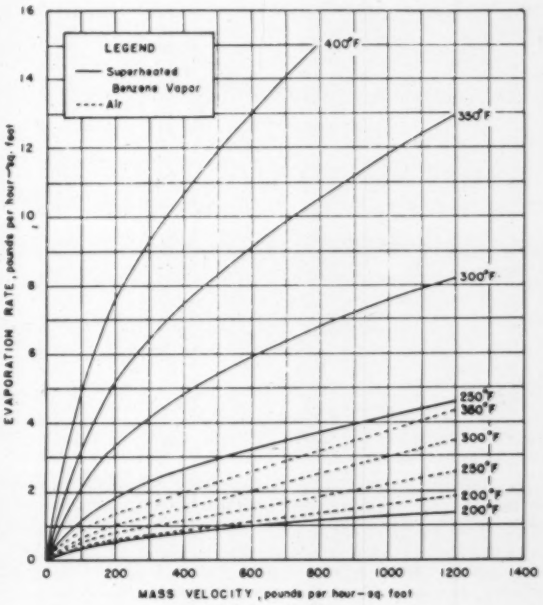

Fig. 6 Rates of evaporation of benzene into superheated benzene and into air

used as the heat-transfer medium in spray-drying of solutions or emulsions.[6] However, little work has been done to prove one way or another the practicability of such equipment. If the heat-transfer coefficients observed in surface drying with superheated vapors can be expected to apply as well in vaporization from droplets then we can expect in the future to see many applications of this type of work because of the advantages already given for superheated vapor drying and also because of the new physical forms which may be produced when spray drying in this atmosphere.

At the present time a great deal of work is being done on superheated-vapor drying technique using a continuous-tray drier of the turbotype.

Fig. 7 shows a pilot-plant installation of a turbotype drier which has been in operation for several months. Rates of drying are two to three times those observed when drying with air at equivalent temperatures. Superheated steam at atmospheric pressure and temperatures from 300 to 450 F has been employed as the drying medium.[6] The superheated-steam atmosphere is generated from the moisture in the material. The materials tested in this unit were micron-sized inorganic materials with high-temperature limits. When filter cakes of these materials are dried in air they tend to disintegrate and form extremely fine dust. However, when dried with superheated steam the pieces of filter cake show little tendency to fall apart or form dust. In this installation the superheated exhausted vapor is sent directly to atmosphere without any apparent dust loss.

Heat is provided by burning gas in four U-shaped radiant-tube heaters located in the space between the drier housing and the rotating trays.

Turbine-type fans located within the drier are used to circulate the drying medium over the material much as a fan circulates air within a room. As a result there is no pressure drop across the drier because of circulation

[6] "The Chemitator," column edited by E. T. Thompson, Chemical Enginering, vol. 62, September, 1955, p. 104.

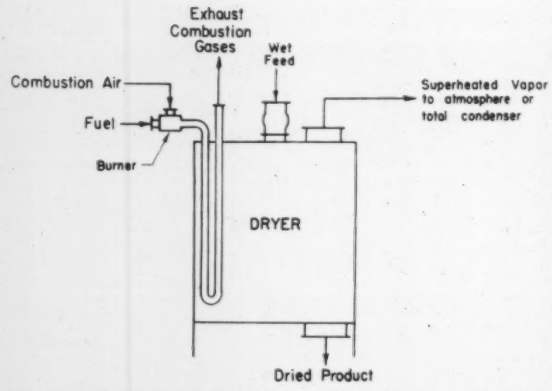

Fig. 7 Superheated-steam drier with internal radiant-tube heaters

of the drying medium. The turbotype drier, therefore, operates at pressures very close to atmospheric pressure. Leakage of air into the unit or solvent vapors out of the unit is prevented without going to elaborate sealing devices.

When the liquid being vaporized is a flammable organic solvent which is to be recovered, steam-tube heaters can replace the radiant-tube heaters within the the drier. The superheated solvent vapor is exhausted to a total condenser for complete recovery of the liquid.

In a drier installation scheduled to go into operation in 1956, an organic solvent is to be vaporized from an organic solid. The heat is to be provided by steam-tube

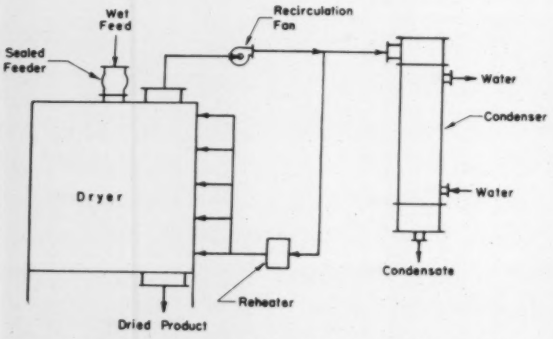

Fig. 8 Superheated-vapor drier with external recirculation and total condenser

heaters using high-pressure steam. The steam temperature is, however, above the melting point of the solid, making it necessary to locate the heating elements outside of the drier where they cannot be fouled by dust which might be blown against them. The preheated organic solvent vapor is introduced into the drier at several levels through a vertical manifold duct. By controlling the quantity of superheated vapor introduced at each inlet, the temperature in each zone can be controlled. The circulation of the vapors over the material is constantly maintained by the internal turbine-type fans. A quantity of vapor equivalent to the preheated vapors introduced plus the solvent evaporated is exhausted through a wide-area exhaust breeching where dust present settles back into the drier. The vapors are then passed through a recirculation fan to a partial condenser where the solvent evaporated is condensed out. The condenser has been designed to act as a scrubber to scrub out any traces of dust in the vapors before the uncondensed portion is returned to the reheater and then to the drier.

Where the solid has a low melting point but is not dusty, greater heat economy can be obtained by arranging the recirculation stream as shown in Fig. 8. The exhaust is split into two streams. A portion equivalent to the solvent vaporized is sent to a total condenser for recovery. The remainder of the superheated solvent-vapor exhaust is sent to the reheater and then back into the drier.

An arrangement, Fig. 1, has been developed which combines several of the features mentioned; such as, internal steam heaters, recirculating fan, partial condenser, and steam reheater for the vapors returned to the drier.

Drying with superheated solvent vapors was retarded by the fear of explosion associated with their use and by their toxicity if allowed to accumulate in unvented spaces. The advantage of operating the drier at a slightly subatmospheric pressure (less than 0.01 in. H_2O) as is possible in the turbotype drier, is therefore apparent.

For safe operation, provision must be made for purging the system of air during start-ups and shutdowns and for instrumentation which will indicate the accidental presence of an explosive mixture within the system or an excessive concentration of vapors in the surrounding space.

Future Investigations

Comparatively little investigation has been carried out on the drying of solids with superheated vapors, especially in the falling-rate period. It is expected that the drying time in the falling period will be considerably shortened in superheated-vapor operation because of the higher temperature level maintained in the solid. This would be highly important for those products which have a long drying time in the falling-rate period.

Investigations are needed on the physical changes that occur during superheated vapor drying as compared with air drying. At increased drying rates, the bulk density of some products may become lower. Other physical properties of the superheated vapor-dried product may also be radically different from an air-dried product.

The question of the equilibrium-moisture content of a superheated-vapor dried product requires considerable study before general conclusions can be drawn. There is some question whether there can be an equilibrium moisture content with superheated vapor. It is known that the void spaces of a dried product are filled with the superheated vapor which should be regarded as residual moisture. This residual moisture cannot be removed by superheated-vapor drying. Deliberate controlled purging with air is mandatory in the case of flammable vapors for safety reasons. Purging is also necessary in any case where low moisture contents are desired.

The possibility of drying with superheated vapors, although not new, is only now reaching commercial feasibility. The practicability has been demonstrated and commercial equipment is available. Engineering and design-improvement programs are actively being pursued to provide better superheated-vapor drying equipment and auxiliaries at lower cost.

The Engineer Looks at Management Positions

Wide range of opportunities exists for the young engineer and means are being provided to achieve his aspirations

By R. P. Kroon, Fellow ASME

Director of Research, Aviation Gas Turbine Division, Westinghouse Electric Corporation, Kansas City, Mo.

Some fortunate individuals in engineering organizations know at an early stage in their career whether they desire to enter into management positions or whether they want to develop along technical lines.

At times, the choice appears obvious. One may expect the extrovert who likes to deal with people, the decisive man of action, to aspire toward management positions. One may anticipate that the creative introvert, the man who is a thinker rather than a doer, the gadgeteer, is destined for a technical career. But more and more frequently we see the supposedly secluded scientist, the college professor of technical renown, emerge to administer a multimillion-dollar project and doing a creditable job. And so it seems that an increasingly large percentage of engineers are equally fit to be either administrators or technical experts.

The Choice—Engineer or Manager?

This paper is intended to provide some guidance in the important choice: Engineer or Manager?

Until a short time ago the financial advantages of managerial positions were such that it was difficult for the technical man to turn down an administrative job. But this situation is changing. It is being recognized that capable technical people, in the complex industrial world of today, can influence the whole direction of new developments and be responsible for success or failure of the whole enterprise.

Today in the author's company, and no doubt in other organizations as well, the technical man and the administrative man can achieve the same salary levels within the engineering departments. As a matter of fact, the technical promotion through advisory engineer to consulting engineer is an exact parallel to the administrative promotion through supervisory engineer to engineering division manager, both with respect to financial compensation and to prestige. Within limits, therefore—I am excluding company presidents and other high-ranking officers—financial considerations need not influence the choice between a technical and an administrative career.

As someone who has been involved both on the technical side and the administrative side of engineering, may I make some comments about the two types of positions.

Creating—designing a machine, making something that works, inventing a new method, developing a new formula—is for the technical man a deeply satisfying activity. Some people must invent just as others must compose or paint. No doubt it is this phase of engineering which attracts the "teenager" who wants to become an engineer. To the scientifically minded engineer, delving into the unknown, exploring the laws of nature, is a fascinating occupation. Becoming an expert in his field brings him in touch with like-minded individuals whose acquaintance he cherishes.

The technical man usually considers himself fortunate in being able to concentrate on relatively few problems, as compared with the manager who is likely to be involved in ten to fifty subjects each day. But he may be frustrated by conditions about which, as a nonsupervisor, he has little control.

The prime attraction of a management position is that it makes the holder a more influential person. He can make policies—though usually within limits. As one of our young supervisors put it, he is in a position to help others. Through his group the manager is able to accomplish a great deal more than he ever could by his own personal efforts. While he finds that his decisions must be based on much more superficial evidence, he also discovers he can remain creative, applying himself to more difficult organizations or better working methods.

The young supervisor represents management as far as his employees are concerned. He has an equal responsibility to represent his employees before management. Sometimes he may find that he cannot be loyal to both all the time. One of the greatest problems of the young supervisor is how to compromise and like it.

He will usually find that his social contacts will increase greatly. He may learn that his increased obligations leave him less time with his family.

Burleigh B. Gardner[1] lists eleven essential qualifications for executives. Many of these apply as well to the lower-level supervisor and, as they represent an interesting sociological approach, these qualifications are quoted here: Successful executives must

"1 Accomplish and achieve in order to be happy.
2 Submit to authority without resentment.
3 Have strong drives toward material rewards and prestige.
4 Possess the ability to bring order out of chaos.
5 Be decisive.
6 Know what they are and what they want.
7 Feel they have to keep moving, be active.
8 Have a pervasive fear of failure.
9 Concentrate on the practical, the immediate, and the direct.

Contributed by the Management Division and presented at the ASME Engineering Management Conference, St. Louis, Mo., March 14–15, 1956.

[1] Quoted in the article, "The Executive Crack-Up," by Richard Austin Smith, *Fortune Magazine*, May, 1955.

10 Be able to identify themselves with their superiors, who constitute a symbol of the achievement and activity they desire for themselves.

11 Feel and act as though each were a 'man who had left home,' i.e., had severed emotional ties and obligations with his parents."

Probability of Promotion

Let us now assume that our young engineer has made up his mind that he would like to become a supervisor. What are his chances for promotion? This is an interesting statistical question, which has been studied by Mr. W. F. Thompson of our organization. The problem posed is this: In a typical engineering organization, what are the chances for promotion from one level to the next higher one? Obviously the answer to this question depends on many factors such as the ratio of nonsupervisory and supervisory personnel, age levels and age limits, mortality rates, and the like. One very important variable, with which we will be concerned here, is the rate of expansion of the company or the industry being studied. The question of whether an industry is growing, or whether it has become stabilized, has a pronounced effect on the chances for promotion.

If we look upon each industry as a self-contained unit, it is obvious that transfers from one company to another within the same industry do not affect the overall probability of promotion within the industry.

It also should be pointed out that the study presupposes that all engineers entering the organization are eligible to become supervisors.

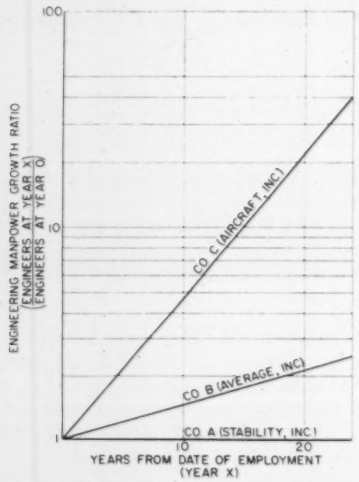

Fig. 1 Growth of engineering manpower in three representative situations

In his study Mr. Thompson has evaluated three types of industries. The first one ("Stability, Inc.") represents an industry which has become stagnant; i.e., its rate of growth is zero. The second one ("Average, Inc.") corresponds to the average growth in the engineering profession. The third ("Aircraft, Inc.") is indicative of the aircraft industry, where the expansion has been very rapid. The growth curves for these three industries are shown in Fig. 1.

On the basis of reasonable assumptions regarding the ratio of supervisors to nonsupervisors, and so on, Mr. Thompson finds that the probability of being promoted to first-level management at some time during the working lifetime is as follows:

	Per cent
A, Stability, Inc.	35
B, Average, Inc.	50
C, Aircraft, Inc.	95

These answers, illustrated in Fig. 2, indicate:

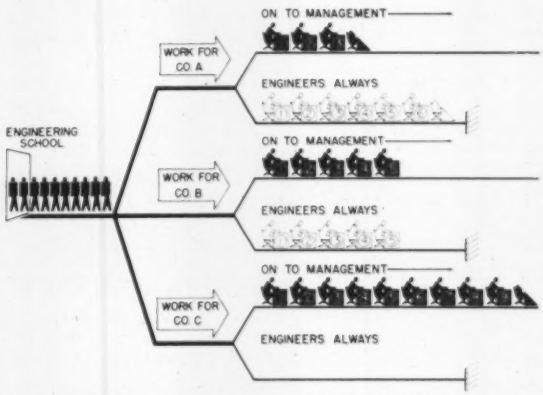

Fig. 2 Probability of advancement to first-management level during working lifetime in three industries of Fig. 1

1 The engineer who desires to become a supervisor does well to select a rapidly expanding industry.

2 Where an industry grows as rapidly as the aircraft industry, the demand for capable supervisors exceeds the probable supply of qualified personnel. It is most unlikely that some 95 per cent of the new engineers entering the industry are potential supervisors. Supervisors will be brought in from other related industries.

An interesting example of the effects of rapid organizational growth is that of the U. S. Air Force during World War II. The young Air Force colonel, compared with his counterpart in the senior service, the captain in the U. S. Navy, was a natural product of rapid promotion necessary in an organization which was expanding at a very fast rate.

Management Development

What Can the Individual Do?—Today the young engineer can prepare himself for management infinitely better than his predecessor. One generation ago, accepted practice was to inform the newly elected supervisor about his new status—and to wish him good luck. Today opportunities for education in management techniques, human relations, business administration, and the like, are readily available to anyone interested in management. "Management Development Programs" have become a vital part of the modern engineering enterprise. Such programs can accomplish the following objectives:

(*a*) To analyze the organizational structure from the standpoint of responsibilities and to make sure that these responsibilities are understood by the individual.

(*b*) To help individuals to become more effective and to provide an atmosphere for individual growth.

(*c*) To build up a reservoir of personnel with leadership potential.

From the individual's standpoint, one of the most valuable elements of the program can be a periodic frank discussion of his performance. This discussion serves to bring out:

1 What does he hope to achieve.
2 What are his strong points and his weak points.
3 What help does he desire from the company. (Training courses, different assignments, counseling on the job. . .)
4 What can he himself do to improve himself. (Study, public speaking, outside activities. . .)

What Can the Company Do?—Industrial concerns can promote the development of capable supervision in several ways:

(*a*) Take a real interest in the individual engineer's growth. One of the most frustrating experiences for the young engineer is to land in an organization where his presence is taken for granted and where nobody cares about his progress. The prescribed counseling, which is part of "management development," can do a great deal to orient these men and to help them to attain their full potential. Many managements today recognize that in a business enterprise there are many roadblocks to advancement over which the individual has no control. They realize that while no combination of company programs in itself can provide the motive power to propel the individual forward, management has a responsibility to employees to provide assistance in improving their performance and to their stockholders to insure qualified management succession by eliminating as many of these roadblocks as possible.

(*b*) Provide diversified experience. Having determined that an individual has management potential, we should consider for what kind of a position he appears potentially best-suited. It then becomes a relatively simple matter to review the experience of the individual in relation to the experience requirements of the type of position toward which he seems able to grow and to make sure that the individual gets the kind of work experience he needs. This type of planning is probably more necessary in larger companies where it is sometimes difficult for the individual to acquire the diverse and broad experience he needs for management positions today.

(*c*) Promote employee education. Many companies provide assistance to their employees to enable them to work toward advanced or undergraduate degrees in their field of work. This helps primarily to increase their competence with respect to their present responsibilities.

Various types of management education and training also are being made available by many companies. In our own case, for instance, we have in recent years added Business and Management courses to our Graduate Study Program. For men with technical backgrounds we have included a special program to provide them with a foundation of business-administration education upon which they can build. Enrollment in these courses provided now at eight company locations is averaging about 600 men per year.

There are, of course, many other types of education and training being used today both in company and outside as a means of broadening individual horizons and knowledge of general business-management principles. There are, to cite two examples, the advanced management programs at universities all over the country, and the broad education in the humanities which the Bell Telephone Company has undertaken. There are, too, many different types of in-company management-training programs to be included within the scope of this paper.

(*d*) Assist the colleges. Starting with the war period, the drain on teaching personnel has been terrific. Attractive offers of industrial employment have lured away many good teachers. In the interest of raising the standards of engineering employees, industry now has an obligation to help the universities by means of scholarships or grants or in any other way that will help them to engage or retain a highly competent teaching staff.

(*e*) Relieve the engineer from jobs that can be done by others with less training. With the present great scarcity of technical personnel, it is wasteful and it stunts the growth of the engineer to have him perform tasks such as repetitive curve plotting, data taking, and monotonous computations. By training technical assistants, or by acquiring automatic computing or data-taking equipment, industrial concerns can improve operating efficiency and raise the level of their engineering personnel.

Effect of New Industrial Trends

During the past few decades we have witnessed several developments which have affected the nature of managerial positions to such an extent that the over-all change has been almost explosive. These developments are familiar to all of us—they have taken place in front of our eyes so to speak—yet their influence on the supervisor's job has perhaps not been fully realized.

(*a*) Technical operations have become a great deal more complex. Symbolic of the turn of the century—two generations ago—was the lone inventor who, in a garage or perhaps a small laboratory, was able to achieve a "technical break through." Men like Edison, the Wright Brothers, Ford made their great technical innovations with what today looks like a bare minimum of facilities and organization. Recent achievements—the exploitation of atomic energy, the development of the gas turbine, the supersonic aircraft, the guided missile—would have been impossible without the collaboration of large numbers of physicists, chemists, metallurgists, and engineers in many organizations, often with very elaborate facilities and supporting staff.

(*b*) The past few decades have seen the evolution of new, highly technical, industries such as the electronics and computer industries, just to mention a few. Even where the product has remained the same, the method of producing it has required a much more significant effort,[2] by means of control devices, servomechanism, and automation. Typical of the new era is the company that sells technical services, i.e., the brainwork of its employees, exclusively.

(*c*) The industrial manager no longer faces his many problems barehanded. He has access to a number of tools to do a more intelligent job. He has available

(*Continued on page 453*)

[2] While the "value added by manufacture" for industry over-all increased 63 per cent between 1947 and 1953, corresponding increase for manufacturing mechanical measuring instruments was 138 per cent, electrical measuring instruments 162 per cent, and scientific instruments 188 per cent. (1953 Annual Survey of Manufactures—U. S. Department of Commerce.)

Utilities Systems for a 30,000-Barrel-Per-Day Refinery[1]

Background and demand factors leading to selection of equipment and a brief description of the plant layout

By C. E. Peterson, Associate Member ASME

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RECENTLY construction was completed on a new refinery designed to process 30,000 bbl per day of crude oil. This refinery includes a generating station to supply steam and power to the oil-processing units, auxiliary equipment, and buildings.

In many instances steam generation is the sole function of refinery boiler-plant installations, with the demand for electricity being met by purchased power. In recent years, however, many refinery central stations have been built which use the "by-product" power cycle.

A simplified diagram of this cycle is shown in Fig. 1. This cycle utilizes high-pressure steam for the turbine-generator. Exhaust from the turbine, still at relatively high pressure, is then used for process, and mechanical drivers throughout the refinery. Steam needed in addition to the turbine exhaust is diverted through pressure-reducing valves and desuperheating stations into the same system as the turbine exhaust. A low pressure-exhaust steam system is, of course, used for heating and to receive exhaust from refinery turbine drivers.

The problems met in designing a refinery boiler-plant installation using by-product power differ from those experienced in designing a more conventional power plant in several respects: (1) The turbine-generators have a high back pressure with no surface-condensing equipment, and this makes the cooling-water requirements relatively small. (2) Since much of the steam distributed to the refinery units is not reusable or recovered, feedwater make-up to the boilers approaches 100 per cent, and the boiler-feedwater-treatment facilities are therefore more extensive. Blowdown rates are similarly higher for the same reason. (3) Electrical and steam-load factors are high since the refinery operates 24 hr a day, and fluctuations tend to be seasonal, rather than daily and seasonal.

Determining the Requirements

During the preliminary planning stages for the new refinery, the steam, electrical, and cooling-water loads were estimated using other existing refinery units as a basis. These established loads were then ratioed up or down depending on the oil throughput of the existing units as compared with the oil throughput of refining units planned for the new 30,000-bbl-per-day refinery. Since preliminary estimates tend to be low, a safety factor was then applied in establishing the capacities of equipment.

[1] Presented at the 1955 prize contest for younger mechanical engineers, conducted by the Chicago Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. This paper received second prize. Slightly condensed.

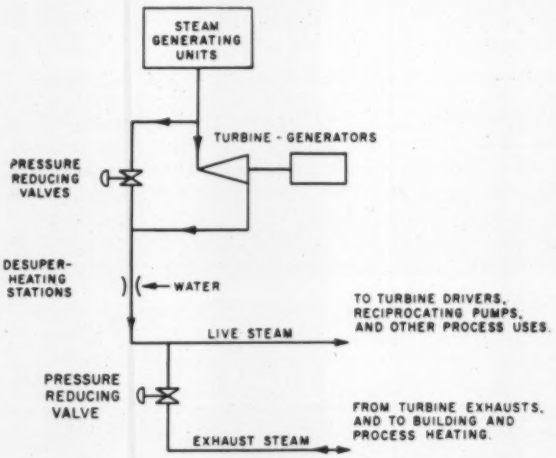

Fig. 1 Simplified diagram showing by-product power cycle

At the new refinery the steam loads are greatest in the winter because of the process, and building heating load. Normally, the electrical-load picture would be reversed with the peak loads being in the summer because of refinery cooling-water pumping, and cooling-tower fans, if cooling towers are used. At the new refinery, however, the seasonal electrical-load fluctuation is small. This is due to the pumping of heavier petroleum products (such as heater oil) in the winter over a new-products pipe line between the refinery and a products-distribution terminal some 200 miles away. This increased electrical-products pipe-line pumping load in the winter offsets the increased electrical-cooling water pumping load of the refinery in the summer, and makes the electrical load fairly constant the year around.

Early studies of the steam and power loads at the refinery indicated that a steam-generating pressure of 650 psig, with a turbine-exhaust pressure of 125 psig, would result in the most satisfactory by-product power arrangement. Steam at 125 psig from the turbine exhaust and from the pressure-reducing and desuperheating stations, as required, is then distributed throughout the refinery for mechanical-drive turbines, reciprocating pumps, and other process uses. An exhaust-steam distribution system which operates at about 25 psig is also located throughout the refinery. This system receives exhaust from mechanical turbine drivers, and serves as heating steam. A pressure-reducing valve can divert 125-psig steam into the exhaust-steam system if nec-

essary. In choosing between electrically driven and steam-driven equipment, and in selecting heat-transfer equipment at the refinery, one factor always considered was the steam balance, and the undesirability of dumping exhaust steam to the atmosphere at any time.

Major Equipment

Water for the new refinery is obtained from the river adjoining the plant site. Records showed that turbidities as high as 30,000 ppm have been encountered in the past during high water. The effect of a recently completed dam upstream was taken into consideration, however, and allowed water-clarifying equipment to be designed for a maximum inlet turbidity of 15,000 ppm.

Water Treatment. All river water is first pumped to a 60-ft-diam × 17-ft-high clarifier where the turbidity is reduced to 10 ppm. A lime and/or alum solution is mixed here with the water to form a floc, or coagulant. Mixing takes place in the center section of the clarifier, and flow is radially outward where a reduction in velocity, and changes in direction cause the floc to settle. This floc carries with it the suspended matter in the water. The sludge, composed of floc and suspended matter, is collected by rotating scrapers on the bottom of the tank and ejected. Clear water is collected from an overflow-weir arrangement at the surface of the water.

Normally about one half of the water from the clarifier is used for cooling-tower make-up. Clarified water is also used for fire water and service water throughout the refinery when required. The remainder of the clarified water is then pumped to a 21-ft-diam hot-lime sedimentation tank to be treated for boiler-feedwater service. Here the water is raised to 240 F by exhaust steam to enhance the softening reactions that take place. A lime slurry is injected into the top of the tank to form a sludge blanket in the lower, conically shaped section of the vessel. The hot water passes downward through a center section, and then slowly upward and outward through the sludge blanket where the water is partially softened, and some silica is removed. A blowdown arrangement keeps the sludge blanket at the desired thickness. The sludge blown down from the lime-sedimentation tank is pumped back to the clarifier to aid in settling the suspended matter out of untreated water.

From the lime-sedimentation tank the treated water is pumped to pressure-type filters which use treated anthracite as the filtering medium to remove the last traces of precipitate. Five 8-ft-diam filter tanks are sized, and are so arranged that any one of the filters may be taken out of service for backwashing.

The treated and filtered water then enters zeolite softeners where calcium and magnesium salts are exchanged for the more soluble sodium salts. Water leaving the zeolite softeners is then at essentially zero hardness. There are four 7-ft-diam softeners arranged so that any one may be backwashed, regenerated with a brine solution, and rinsed, while the other zeolites are in service.

Water treatment also includes oxygen removal in a deaerating feedwater heater to prevent corrosion, and the injection of sulphite into the suction side of the boiler feed pumps to scavenge the last traces of oxygen. Phosphate solution is also injected into the boiler drum to inhibit scale formation. The boiler-feedwater-treatment facilities for the new power station have been designed to treat over 300,000 lb of water per hr.

Boilers. Two 150,000-lb-per-hr, two-drum, bent-tube boilers have been installed. Steam is generated at 650 psig and 755 F total temperature at the superheater outlet. Four combination-type burners arranged to burn either fuel oil or fuel gas are installed on each boiler. The combustion-control system, which is pneumatic, is arranged normally to burn all the waste-fuel gas from the refinery units that is available; the remainder of the fuel required oil. The fuel-oil pumps and heaters in the station are dual purpose as they also pump and heat the fuel oil for the process units. Fuel oil is continually circulated to and from these units in steam-traced lines.

Induced and Forced-Draft Fans. The boilers have no economizers or air heaters; however, the fans and ductwork have been arranged for installation of air heaters in the future if it is deemed desirable. The induced-draft and forced-draft fans are turbine-driven, and are not spared or dual-driven. A header-type piping layout has been used so that fans on either boiler may be started using steam from the other boiler. If both boilers are down, the fans may be started using compressed air from one of the motor-driven plant air compressors located in the power station. This air compressor is connected to the emergency power system, and therefore is operable even during periods of complete shutdown. Compressed air was successfully used to drive the fan turbines for the initial start-up of the first boiler.

Feedwater Heating. A high-pressure feedwater heater is located between the boiler feed pumps and boilers to improve the heat cycle. Because of the high continuous blowdown rates, a flash tank has been incorporated into the blowdown system. Flashed steam from this tank is then used for feedwater heating.

Turbine-Generators. Two turbine-generators are installed in the plant, each rated at 2500 kw when operating at 3600 rpm and 0.80 pf. Generation and distribution is at 4160 volts. Initial starting power, as well as emergency power for crucial pumps, controls, and lights, is supplied by a tie with the local utility company. In order to reduce kilowatt-demand charges, only the critical loads mentioned are relayed to be energized by emergency power in case of a power failure.

Air Compressors and Pumps The plant air and instrument air compressors for the refinery also are located in the power station. All instrument air is dried to a dew point of —40 F by an absorption-type drier. The discharge from the spare plant air compressor can be diverted through the drying equipment also, and enables this compressor to serve as a common spare for the instrument and plant air systems.

Normal drive for pumps in the power station is, for the most part, electric, with the spares being turbine-driven. Exceptions to this are the boiler feed pumps, where the normal drivers are steam turbines.

Cooling Tower. The cooling tower is an eight-cell, induced-draft type designed for an outlet temperature of 75 F when handling 17,000 gpm. The cooling-water pump house is located on one end of the cooling tower, and contains the fire-water pumps for the refinery in addition to the cooling-water circulating pumps.

Plant Layout

A layout of the station is shown in Fig. 2. As can be seen, the station might better be called a "utilities" building since much of the water-treatment equipment, the boiler plant, power-generation equipment, the refinery-plant air compressors, the refinery-instrument air

compressor, and the dual-purpose fuel-oil pump-and-heater set are all located under one roof.

Lime and alum for the clarifier are unloaded from hopper-bottom cars on the east side of the building, and are elevated by a bucket elevator to outdoor storage tanks located on the roof of the building. The chemicals are then fed into chemical proportioning equipment located inside the building, directly underneath. Lime from the lime-storage tank also can be dumped into a weigh larry and rolled to the lime mixing tanks to make up the lime slurry for the hot-lime sedimentation tank. Salt for regenerating the zeolites is unloaded from box-cars on the east side of the building also, and is fed by a portable conveyer into underground brine pits.

The boilers have been arranged opposite hand so that both sets of burners can be reached from a common operating platform. The induced-draft and forced-draft fans are located out of doors under a shed-type roof. The boilers are enclosed except for the west ends. The deaerating feedwater heater is located on the roof, as are the pressure-reducing and desuperheating stations.

In addition to the flow meters required by the combustion controls, and by the chemical-proportioning equipment in the water-treatment system, steam leaving the power station and steam required by the individual refining units is also metered for accounting purposes.

Total construction time for the entire refinery, including the power station, was less than 18 months. Actually, the power station was in operation about a month before the rest of the refinery. Most of the power-station personnel were locally hired, and many were sent to other refineries to gain operating experience on similar equipment.

Although the usual few minor difficulties were encountered in placing the station into operation, the plant in general has operated satisfactorily since its start-up.

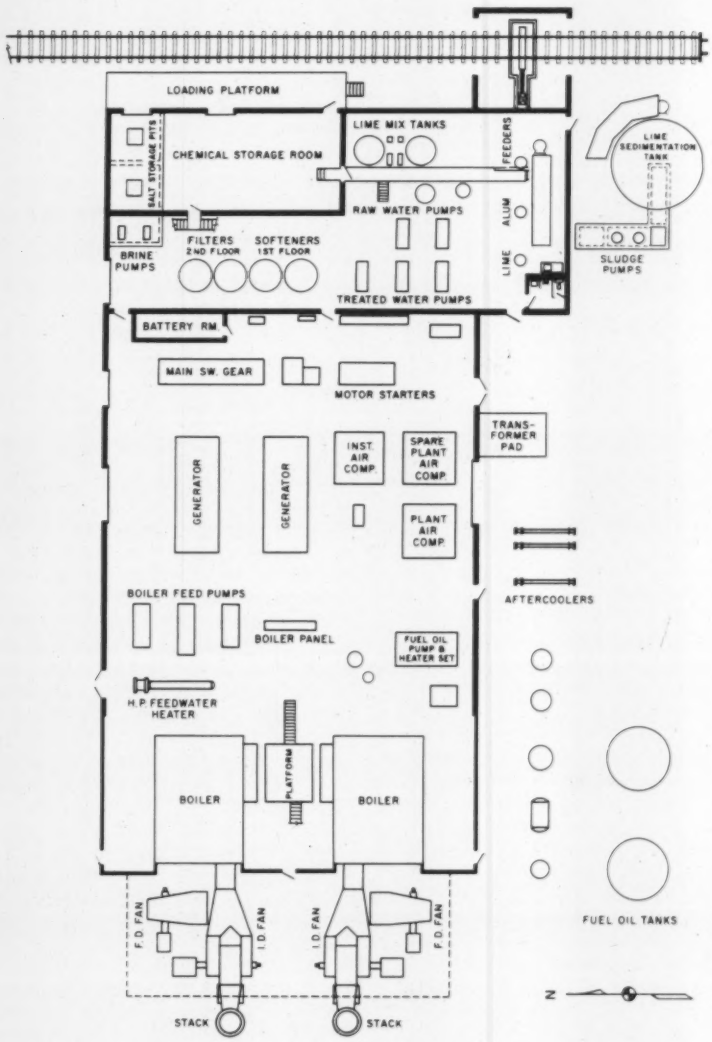

Fig. 2 Arrangement of boilers, power-generating equipment, and auxiliaries which constitute the utilities system for the refinery

The Shortage Re-Examined

Some elements of a grand strategy for augmenting our scientific and engineering-manpower resources

By James R. Killian, Jr.

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THERE is a story about a cello player who sawed away continuously on a single note. His wife remarked to him that other cello players seemed to move their fingers up and down the strings, producing less monotonous sounds.

"Oh!" replied the cellist, "they are looking for the note. I've found it!"

Recently I have been asking myself whether, along with many others, I have *the* note or whether I have not restricted myself to too few notes in discussing our current manpower requirements in science and engineering. I have an uneasy feeling that we may have become bemused by numbers and by oversimplified quantitative measures and remedies in evaluating our manpower needs in the broad field of technology—defining technology as the combination of science, engineering, and production. That we have an acute shortage of available effectively used competence in many fields of technology there can be no reasonable doubt. Neither can there be a reasonable doubt any longer that this scarcity is a clear and present danger to the nation and to the entire free world.

My theme does not involve challenging this scarcity or its danger to the nation. It does emphasize the need for a better understanding of the nature of the shortage and of the paramount importance of qualitative factors in any plan for meeting our manpower needs. I wish particularly to examine ways in which our educational system must respond to our manpower needs and how current attitudes and values with respect to science may affect the supply of scientists.

If we are to promote action on a grand scale for augmenting our scientific resources, we need to look at every factor that might help. Consequently I wish to suggest some of the elements of a grand strategy which must be stressed *along with* increasing the quality of our science teaching and countering Russia's remarkable technological build-up and the grim threat it holds for us.

Shortage of Talent

With these guide lines before us, let us now look at the nature of the present dearth of scientists and engineers in the face of a greatly increased demand. It is not simply a shortage of men. First and basically, it is a shortage of intellectual talent adequately educated and in the right place. Second, it is more a shortage of specific talents and skills adaptable to specific areas than a general shortage of numbers.

The shortage of high talent is aggravated by the fact that too many young people of exceptional intellectual ability drop out of our educational system before they have achieved an education which fully exploits their abilities. The loss between high-school and college graduation has been repeatedly reported. Of the ablest 50 per cent of high-school graduates only about a third show up on the list of college-degree recipients. Of the top 2 per cent of our high-school graduates only about two thirds now graduate from college. From these facts we draw two morals. The first is that too many of our ablest youth fail to get the kind of education their abilities deserve. The second is that without dropping standards we can achieve only a limited increase in our college population by stepping up the percentage of high-school graduates who go to college. Both these conclusions stress the importance of motivating and using more of our exceptional talent and directing our attention to its conservation and cultivation.

In a recent letter prepared for the subcommittee on school goals of the Committee for the White House Conference on Education, Mr. Dael Wolfle has made the following observations about the relation of the scientist shortage to our resources of talent:

"We must plan our educational programs to encourage more of the bright youngsters to prepare for scientific and technical careers. It is debatable, however, as to whether the most effective method of securing that end is to concentrate on young people who may become scientists or to concentrate on those of high ability. A scholarship for a student to study science may help, but not if his high-school experience has been so discouraging as to turn him away from higher education in any form. Improved high-school instruction in science may help, but not if the youngster grew up in an environment that puts high value on getting out of school as soon as possible.

"The loss (between high school and college) could be reduced by provision of a larger number of college scholarships. It could be still further reduced by so changing the high-school curriculum as to provide a more stimulating and challenging four years of learning and experience for the brightest high-school students. It could be still further reduced by those, necessarily slow, social and cultural changes that would place greater emphasis upon the importance of education, as distinct from diplomas, and upon the importance of recognizing high ability and giving it full opportunity for development wherever it may be found.

"Since the effectiveness of different methods is debatable, but the importance of scientific manpower perfectly obvious, my own preference would be to devote

Annual Sigma Xi address presented at the 1955 meeting of the American Association for the Advancement of Science, Atlanta, Ga., December 27, 1955.

our educational, scholarship, guidance, and encouragement efforts to boys and girls of high ability, whatever their fields of special interest, to plan educational programs for as much flexibility as possible by keeping alternative paths open, to keep careful watch over the number of students preparing for careers in science, and only to abandon the broader and, I believe, more socially desirable approach in favor of special treatment for prospective scientists if it appears that we are not likely to get enough scientists out of our broader attack upon the general problem of recognizing, encouraging, and developing high ability."

Augmenting the Talent Pool. I find myself in agreement with Mr. Wolfle's analysis and his preferred policy. For the long pull I think the nation would be better served by augmenting the total pool of exceptional talent so that all of our professions benefit rather than by giving exclusive attention to getting more talent into science and engineering, even though the need for manpower in these fields is at the present time the most urgent. If we attempt to build up science and engineering through methods which apparently deprive other professions of a fair share of the talent pie, we may generate a host of undesirable reactions and side effects inimical to the welfare of science in the long run. We might also attract into science too many whose talents and predilections were more compatible with other kinds of careers and who would therefore become indifferent scientists and engineers.

Lack of Understanding in Secondary Schools. One of the reasons we are in trouble now is that some secondary teachers and administrators have placed a low value on science and have shown an inadequate understanding of its intellectual requirements and its importance to our society. As we seek to give science its proper place and emphasis in the secondary school, I hope that we do not overshoot and place a low value on other fields and thus bring about their neglect.

Whether there is agreement among scientists with the line of action proffered by Wolfle, I think there will be agreement that any grand strategy for augmenting our scientific manpower must be related to a concerted effort to identify, encourage, and more fully educate the top talent among our youth.

Qualitative Aspects of Manpower Shortage

In reviewing the clinical evidence on the nature of the manpower shortage, let us next take a reading on the qualitative aspects of the current excess of demand over supply, using as our example the field of engineering. One has only to talk with the placement officers of our scientific and technological institutions to get revealing evidence of the increasingly selective demand for engineers. Employers are not looking merely for "bodies" with degrees; they are looking with a critical eye for very special qualifications—for a sound education in fundamentals, for analytical power, for a grasp of the new and advanced fields of technology. They are looking less for specialized competence at the baccalaureate level and more for men who have the versatility to follow successfully any one of several specialties. They are looking more and more for men and women with graduate degrees.

Advancing Technologies. These special placement demands indicate a great shortage of young engineers with a mastery of engineering science and thus a competence to handle new, advancing technologies, such as data processing, internal and external aerodynamics, energy conversion, communications, servomechanisms, "molecular engineering," and solid-state physics for the design of materials, and similar functional components of technology.

Thus industry and government are pressing the colleges for engineers of more advanced education and analytical powers. They are looking for men with a fundamental integrated education in science, engineering, and the humanities rather than for men specialized in some field of technology at the expense of fundamentals. Employers want more scientists and engineers, but they don't think they are meeting their needs by employing narrowly educated ones. In this new pattern of demand lies the pattern for a modernized engineering education as I intend later to emphasize.

Need for Exceptional Qualifications. Similarly, in the basic sciences our most pressing needs are for those scientists who have the imagination and trained creative power to make the discoveries and generate the new concepts which advance science. Quite properly we hear much about the need for basic research and the funds to support it. These needs indeed are great, but greater still is the need for more scientists who have the trained talent, the motivation, and the conceptualizing power to make basic research really basic.

In stressing the need for exceptional talent, I do not minimize the critical shortage of the rank and file of good competent scientists and engineers. Flag officers are not enough to provide a strong scientific attack force, but the really acute shortage is now in the flag-officer group.

These qualitative characteristics of the present shortage clearly affect the design of any comprehensive strategy for relieving the present dearth.

At the Secondary-School Level

In the secondary schools the first order of business is to shore up the sagging emphasis on science and to begin filling in the decimated ranks of science teachers and to do this, not with culls from other fields, but with teachers possessing a grasp of science and the perception to identify and stimulate youngsters with the bent and capacity for science. The dean of one of our schools of education recently came to me with the evidence that the secondary-school system was recruiting negligible numbers of top science majors from the colleges, especially our institutes of technology. In competition with other fields, it could not offer them a sufficiently attractive career. He also noted the apparent reluctance of our science departments and schools to encourage bright young graduates to go into secondary-school science teaching, a situation that was also noted in the first report of the Science Teaching Improvement Program of which the American Association for the Advancement of Science is one of the sponsors. He expressed pessimism about sustained improvement in science teaching unless we could induce more really first-rate young scientist bachelors to elect secondary-school teaching as a career. It is fine to upgrade existing science teachers and to supplement them with part-time personnel, but these are only partial solutions.

The Vocational Counselor. The influence of the secondary-school vocational counselor is growing steadily, and it is of obvious importance that these counselors

understand the scientific manpower needs of the country. It is particularly important that these counselors not harbor misapprehensions about scientific and engineering careers, particularly because so many of them have had no opportunity to gain any insight into science. There is the need which Mr. Wolfle has stressed for earlier identification of scientific talent, such identification coming as early as the seventh grade. There is the need for more rigor, more emphasis on excellence in the secondary school. As President DuBridge has said, we need "to make thinking popular." I suspect that much of the flight from science at the secondary-school level has resulted from the fear of science as a difficult subject to study. In the pejorative argot of the high-school youngster, only a "brain goes for science" and sometimes a brain is considered a "queer." With such attitudes in the ascendancy, science is avoided in favor of subjects which are less demanding, more descriptive, more easily passed, more easily taught.

Parental Duty. Blame for this aversion to rigorous thinking rests with parents even more than it does with the schools. So far we have managed to get along in the United States by displaying an attitude of condescension toward hard intellectual labor in our schools. There has been avoidance, if not evasion, of the intellectual tax which must be paid if our intellectual budget is to be balanced. Any strategy for strengthening manpower resources must give attention to this fatty degeneration (if I may change the metaphor!) in our education. At a time when we are forced to match wits on every front with an alert enemy of growing prowess, America's survival requires that the American people attach a higher value to the hard labor of rigorous thought. Certainly progress in science and technology requires this kind of intellectual work—work which can be invigorating and absorbing even though hard and demanding.

Flexibility of High-School Program. Other aspects of high-school education require attention as we seek to augment our manpower resources. The high-school program should be flexible, so that an early election of program does not commit a boy or girl irrevocably to some prematurely selected career or educational program. Too often gifted young people without all the facts before them elect a program which makes it difficult for them to go to college, if later their sights are raised or their circumstances change. The vocational high school is vitally important in our educational scheme and serves many young people admirably but it never should be so managed or organized that youngsters of college caliber who elect the vocational program find themselves too late unprepared in motivation or training for college. This need for flexibility has a direct bearing on the conservation of exceptional talent for higher education. We must avoid creating dead-end kids who become caught in educational cul de sacs when they have the ability to travel farther up the avenue of education.

What the High Schools Must Accomplish. In making these observations about secondary-school education, I must make clear my conviction that public schools have a much more comprehensive job to do than preparing young people for college. I am surprised at the number of college people, particularly college professors teaching freshmen, who think that the exclusive mission of the high school is to prepare youngsters for college—preferably *their* college. I am equally surprised by others who apparently ignore the fact that one of the extremely important functions of schools *is* to prepare youngsters for college. Because of my natural interest in the education of scientists and engineers, I find that I must keep reminding myself that, although the education of our future scientists and engineers has been neglected with effects endangering the nation, the education of other kinds of people is also important. We should not neglect any one group of youngsters in order to strengthen another.

Secondary schools, it must also be remembered, play a major part in maintaining our fluid classless society. Criticism of the high schools for not confining their programs to teaching the intellectual skills is neither fair nor in the interest of the nation. I hope that methods for strengthening science teaching and increasing the numbers of scientists will not result in unfortunate distortion of this broader function of the public-school program.

Designed to Help All Children. Our schools should be designed to help all children, and the needs of children of different abilities, different backgrounds, and different aspirations. But we do need to come to a better understanding of the importance of priorities and the necessity of discriminating choices so that we can temper our prodigality of aims by sobering considerations of quality, social and intellectual needs, and achievable goals.

At this point in the evolution of our schools the highest priorities should be given to better provision for our intellectually gifted young people, greater stress on the more rigorous teaching of intellectual skills, and on higher standards of excellence for both teachers and pupils.

Improvements in Science Training. I feel that success in promoting these broader objectives for the schools will carry with it improvements in the motivation and teaching of future scientists. I am very skeptical of such expedients as accelerated programs for those interested in science or any efforts to make a sharp vocational distinction between those interested in science and those who are not. It does seem desirable to provide programs in which the intellectually gifted youngster, regardless of his ultimate specialization, can go farther and deeper. Experimental programs are showing that such programs can make it practical to give advanced standing in college and thus to cover more ground during the college period.

At the College Level

At the college level there are many improvements available to us for strengthening our scientific and engineering education. The liberal-arts colleges are of course the principal sources of candidates for our graduate schools of science. The Wesleyan study and others have shown how remarkable has been the success of a number of small liberal-arts colleges in preparing men and women to become distinguished specialists in science. This stresses the importance of still further strengthening the teaching of science in this type of institution and thus attracting more college students to major in science and proceed on to graduate school. Increasing the number of science majors in the liberal-arts college is one of the quickest ways available to us to increase the number of scientists. It will require an attitude in these institutions that does not underrate science—an attitude, as I shall emphasize later, that

sees an understanding of science as one of the requirements of effective liberal living in our technological society.

Shortage of Science Teachers. As the presidents of liberal-arts colleges well know, there is also a shortage of *college* teachers of science, both in terms of numbers and quality. As we alert the nation to the need for more teachers of science in the secondary schools, we also should stress the equally serious needs of our colleges, particularly those institutions where little research is done, as industry and other agencies have drawn the promising young material away by providing opportunities to do research and development and by higher compensation.

I advocate more grants and fellowships to enable professors of science in liberal-arts colleges to have time off from teaching to do research or to have firsthand contacts with creative work in science in our universities or in industrial or goverment laboratories. More thought has been given to making such opportunities available to high-school science teachers than to science teachers in the small liberal-arts colleges. Wherever he may be, the satisfaction, the professional growth, and the teaching effectiveness of the science teacher are enhanced if he can do research or investigation or maintain periodic contact with these activities.

It is not only the liberal-arts colleges that have a problem in providing the environment and professional opportunities adequate to attract and hold able scientists as teachers. Our professional schools of science and engineering have suffered in the competition for top-flight men. Again using the engineering schools as an example, let me review their problems as they seek to respond to the growing demand for engineers, particularly the more selective demands which I have already described.

Competition From Industry. Against the higher compensation and other attractions offered by industry and other noneducational organizations, engineering schools are now more vulnerable and more in danger of serious deterioration than other educational institutions using scientists. They are more vulnerable, even, than the schools and departments of science. The university and the institute of technology are natural habitats for creative scientists. They are not, generally speaking, quite so natural habitats for engineers, whose professional work lies so much in industry and in the field.

The engineering schools are especially vulnerable now because their young and imaginative graduates and teachers—especially those in the advancing, growing fields of technology—are more in demand for noneducational employment than any other group in our educational institutions.

If engineering education is to meet this challenge and reverse or even retard the spreading scarcity of quality in engineering schools that has weakened science teaching in high schools and other kinds of institutions, it must find a way to make engineering schools a more attractive environment for top-flight engineers and thus for top-flight teaching of future engineers.

The Teaching Load. Even though their enrollments have been down, the teaching loads in our engineering schools—exceptions exist, of course—are very high, with the result that their faculties have too little opportunity for the creative work that leads to further professional development both as teachers and engineers. An informed observer recently estimated that only 10 to 20 per cent of our engineering schools had average teaching loads as low as twelve hours per week or less. When we reflect upon the fact that these institutions are hard pressed to maintain their present level of staffing, we can readily surmise how difficult it will be greatly to increase enrollments and to enlarge graduate study without further burdening faculties and without a reduction in the quality of education.

Stronger Graduate Programs. The success of engineering education in attracting and holding more first-rate teachers will depend upon accelerating the development of more and stronger graduate programs. The graduate school and the research associated with it can provide engineer-teachers with the opportunities for professional activities and growth as engineers which they now find chiefly in practice outside of educational institutions. In those engineering institutions where strong graduate schools exist and where there is a fruitful alliance with basic science, an environment satisfying to first-rate engineers has been better achieved.

Engineers With Advanced Training. Of course, more graduate study in engineering is essential for another reason. We need more engineers with more advanced training to meet the increasingly complex technological needs of our society. The engineering profession or our society can no longer be adequately served by a professional engineering education that is predominantly undergraduate. While this undergraduate education has great strength and a vital role in our total national educational task by providing a form of general education built around professional objectives, it must be extended by more advanced training both in educational institutions and in industry. We must also attract into the undergraduate schools more of the students who have the intellectual qualifications for graduate work.

While qualified bachelor's degree recipients in engineering frequently go on for graduate study in other fields such as the physical sciences and management, the amount of advanced study in engineering still seems small compared to the advanced study *required* by the professions of law and medicine. The degrees are, of course, not comparable, but it is nevertheless of some significance that the number of advanced degrees in engineering, both master's and doctor's, in 1953–1954 totaled about 4800 (of this total, only 594 were doctorates) as reported by the U. S. Office of Education, while the total of M.D.'s and LL.B.'s totaled 6757 and 9898, respectively. Without dwelling on the impropriety of comparing apples and doughnuts, the implication is clear that the engineering profession suffers in comparison with the other great professions in the amount of advanced study undertaken. If engineering is to meet the challenge of our advancing technology, it must promote more graduate study of top quality.

A New Approach to Engineering Education. Many educators are also advocating changes in undergraduate engineering courses, and after a long period of *status quo-itis*, engineering education seems to show signs of the bold experimentation and innovation that marked it in its early days in the United States when it was struggling to throw off the unsympathetic sanctions of classical education. There is a spreading conviction that the engineering curriculum must include a larger content of basic science, less of its traditional compartmentalization, more emphasis on such fundamental functional aspects of engineering as materials, thermodynamics,

fluid flow, and energy conversion. These concepts lead inevitably to a more fundamental curriculum for all fields of engineering, with specialization deferred to the last two years of the undergraduate program and even reduced in these two years in favor of pushing real specialization into the graduate years or into the in-service training programs given by industry itself.

Notable new programs representing some of these points of view are now being tried at a number of institutions. Industry, acutely aware of its needs for engineers of more depth, power, and versatility, is encouraging these efforts. Together these new goals seem to presage an increasing number of institutions dedicated to programs that are less vocational and specialized at the undergraduate level and fundamental enough in their basic science and advanced enough in their mathematics and humanities to educate a new breed of engineer more adaptable to our changing technology—the kind of engineer we are really desperately short of today.

Educational Trends. As I sense educational trends at present, we are to witness further efforts to exploit the vertical organization of education whereby the professional and the general are carried along in parallel with fewer discontinuities between the freshman year and the graduate and professional degree. New programs are under way in other professional fields, which may hold useful lessons for the education of scientists and engineers. The new medical-school program at Western Reserve is a striking example, with its organization along functional lines rather than traditional departmental lines.

It is heartening to hear so much stimulating discussion about new approaches to professional education, and I think it bodes well for the future quality of our technology that some of the new ideas are originating in the engineering schools.

A superb opportunity exists to provide a new type of liberal education polarized about science, unified by professional requirements, and relevant to the needs of out technological society. In our institutes and schools of technology there is a vision of a new kind of university, a modern university built around science and social technology rather than classical studies, but embracing the arts, the social sciences, and the humanities as essential and equal partners in its corporate aims and culture.

Whether one agrees or not about these particular concepts of engineering education, the ferment they reflect is important to the urgent task of maintaining and augmenting the quality of our science and technology and of educating professional engineers with a reach and grasp equal to the performance expected by our society.

A Comprehensive Program

In concluding these observations about engineering education, I wish to stress the importance of more variety, differentiation, and innovation in our system. We need more graduate study in engineering but we also need more technical institutes and junior colleges. We need more stress on science in the liberal-arts colleges but we also need the kind of undergraduate program represented by our engineering schools, where a sound general education is achieved in the environment of a professional school.

In undergraduate education of all kinds we need a differentiated system with institutions specializing in accord not so much with subject matter but with the standards of intellectual performance expected of their students. Whether undergraduate education is obtained in a liberal-arts college or in an engineering school, it should be fundamental and never narrow. All these goals and concepts are important in attracting enough top talent into science and engineering and in achieving the quality of professional achievement these great professions must have.

Excellence Is Never in Oversupply. I venture to express two hopes. I hope we keep in mind the possibility that a drop in business activity or in the volume of defense development or production could reduce the demand for run-of-the-mill engineers and scientists. Jobs temporarily might be hard to come by. Such adjustments, however, would not, except temporarily, reduce the demand for superior men; excellence will never be in oversupply for very long.

Second I hope we do not set as our goal an academic numbers' race with the Russians. The Russian educational system serves the state, ours the individual. They are highly specialized in their scientific and engineering education, and we are trending toward more fundamental generalized education, especially at the undergraduate level. Our objectives and our trends are more likely to serve our nation well and to give us the scientific and technological strength which will be indigenous and therefore in accord with our special qualities and ideals. Our goal should be to meet our own indigenous needs superbly well and not to engage in a numbers race.

And now having reviewed some of the ways whereby education must respond to our manpower needs, I come finally to the consideration of those attitudes and values now current in America which complicate our efforts to increase our ranks of scientists and engineers. In these attitudes may be found some of the underlying and less obvious causes for our failure to increase the numbers in these fields in proportion to the increase in national demand.

Antagonism Toward Science

We note today evidence of a surprising amount of fear of science and of a misreading of what science really is.

Some of this adverse reaction arises from anti-intellectualism, from the disdain and distrust toward the learned man and the realm of reason which defaces the surface of our mid-century period like the tropic fungus which blemishes the polished surface of optical glass. Some of the aversion has grown out of the part which science has been called upon to play in the development of weapons.

Antagonism toward science and engineering has also been engendered by a feeling that they are wholly materialistic and antihumanistic. Even in this age of science we have residual legacies from the conflicts

which swirled about great innovators like Roger Bacon, Galileo, and Darwin, and other discoverers. In fact, there is some evidence that we are in a period of fresh reaction against science. Underlying this reaction is one of our great educational failures, the failure to find effective ways of communicating the meaning, the method, and the spirit of science to the nonscientist—a failure for which responsibility must be shared by both the humanist and the scientist. Valiant efforts to take the nonscientist into the arcana of science have been made, such as Conant's program at Harvard and Hilderbrand's at Berkeley, but the problem is still unsolved and is still receiving inadequate attention and creative effort.

Thus the condition of intellectual separatism remains as a deep fault marring our terrain of scholarship. Robert Oppenheimer, in an address in 1953 (The Scientist in Society) gave a superb report of this condition. "I have a great anxiety," he noted, "that our educational directions, far from making us a part of the world we live in...may be even moving in the opposite direction...We live in the world very much affected by science, and even our thinking caps, and our ideas and the terms in which we tend to talk about things, the notion of progress, the notion of a fraternity of scholars and scientists which is so familiar to a Christian life and which has a new twist because of the spread of science—all of these we can see originally at a time when science was understood by men of affairs, by artists, by poets.

We live today in a world in which poets and historians and men of affairs are proud that they wouldn't even begin to consider thinking about learning anything of science, regarding it as the far end of a tunnel too long for any wise man to put his head into. We therefore have, in so far as we have at all, a philosophy that is quite anachronistic and, I am convinced, quite inadequate to our times...Far more subtle recognition of the nature of man's knowledge and of his relations to the universe is certainly long overdue, if we are to do justice to the wisdom which our tradition has in it and to the brilliant and ever-changing flower of discovery which is modern science."

This attitude toward science is described more bluntly in academic circles by well-worn observations. One of these notes that the scientist knows nothing of the liberal arts and regrets it while the humanist knows nothing of science and is proud of it. The other reports an incident in a liberal-arts faculty meeting. When a student named Cicero was reported as having flunked Latin, everybody laughed, but when a student named Gauss was named as having failed mathematics, only the science professors laughed.

This drawing away from science is related to an attitude of antagonism and fear with respect to scientists. The old cliché about the expert is applied to the scientist. The scientist, it is repeatedly said, should be on tap but not on top. He thus is considered to be merely one of the hired men who has no business doing anything but what he is told to do in the field of his specialty. I have heard no statement that the lawyer or banker or economist or production specialist should be on tap but not on top. I do not imply that the scientist has any right or unique qualifications to be on top. I am disturbed by the attitude that, because a man is a scientist, he is disqualified for public or private administrative responsibility even though he may be qualified.

If American science is to continue to prosper, if it is to attract to it its proper complement of creative and gifted minds, we must combat the notions that science and engineering are incompatible with the great humanities disciplines, and that they are narrowly materalistic and destructive of human values. In the face of the practical responsibilities which rest in science and engineering for our security and our material welfare, it is all too easy for people to conclude that science is inimical to the spiritual ends of life and for them to fail to understand that in reality it is one of man's most powerful and noble means for searching out truth and for augmenting man's dignity by augmenting his understanding.

This attitude reflects something wrong in the relationship of the scientist to society and in society's current estimate of the scientist.

Professional Parochialism. I think that the scientist and engineer are themselves partly to blame for the manner their function in public affairs has been derogated. They have tended too much to professional parochialism. They have been preoccupied with their own trade secrets, too little concerned to communicate these secrets except to each other so that the public misunderstandings about science and technology can be diminished by facts and not aggravated by mystery.

Humanist Also at Fault. But I also feel that the humanist has a responsibility for this hurtful condition. There is still too much of the separatist spirit among the lower reaches of the humanists, too much facile criticism of science as materialistic, too much envy of the scientist for his intellectual achievements, too much protesting that only in the liberal arts can the true gospel of man be found. There has been a tendency to make the scientist the scapegoat for the ills of the modern world.

Our colleges and universities must share a heavy responsibility for this separatism, for they have too easily acquiesced in protective tariffs for intellectual vested interests. Is it not true that a spirit of snobbery on the part of both scientists and humanists, each derogating the other, is one of the most virulent forms of antihumanism? I feel so. It is the great humanistic responsibility of our colleges and universities to stress the kinship, indeed the unity, of all knowledge, and to ease the vested interests and snobberies which sometimes appear among learned men. Objectivity, for example, is not the exclusive monopoly of science, nor humanism the tight monopoly of the liberal arts. In these parlous times we need to remind ourselves of this and to seek to develop more sensitive couplings interconnecting the sciences, the social sciences, and the humanities. We need to remember how the great humanists of Greece, of the Middle Ages, and the Renaissance helped to create an intellectual and spiritual environment and attitude benign to the development of modern science. As Crane Brinton observes in *Ideas and Men*, "Science needed not merely an interest in material things;

it needed the intellectual apparatus to devise the incredibly complex ordering of things we call science; it needed above all the long training in the use of reason afforded by the Greek and medieval philosophy and theology our innocent logical positivists like to deprecate.

Humanism is no less important today as an ally of science in the great coalition of learning we seek. The humanist is one of the principal architects and custodians of the benign environment which science requires for its success. The beauty the great humanist creates or makes us aware of, the perspectives of history he reveals, the "vision of greatness" he sets before us, his search for the first-rate in living, the eternal questions he asks—all these activities help to create the great society and the great men which science requires to flourish.

The Scientist's Contribution. We need also to reiterate how the great scientists have broken shackles of ignorance and superstition, given new leads in the social sciences, profoundly influenced and enriched the philosophy and the understanding of men and thereby given a new depth and reach to humanism. As George R. Harrison has eloquently written: "There is no evil, no inhumanity, in the primary task of science, to forward man's love and desire for truth. An increased awareness of truth has often made men uncomfortable but seldom has it made them less human. Science increases the areas of spiritual contact between man and nature, and between man and other men." When I hear our schools of science condemned as citadels of materialism and our liberal-arts schools held up in contrast as the sole custodians of the liberal spirit, or when I hear that our schools of science have the only sound approach to education, I cannot but feel that the true spirit of liberalism and science is forgotten and the symbiotic relationship between the great fields of learning ignored.

The liberal arts of our time cannot be liberal if they reject or disdain science and technology. Thus science and technology cannot fulfill their responsibilities if our scientists and engineers lack the humanistic quality which has been ascribed to the Athenians—the art of making gentle the life of mankind. In our schools of science and engineering we must seek to cultivate this quality.

For Better Understanding of Science. Scientists have an obligation to make this true character of science better understood, not by an arrogant advocacy of science and technology as the only objective means to increase our understanding and well-being, but by the balanced and tolerant presentation of science as one of the powerful means by which man can increase his knowledge and understanding and still remain humble and ennobled before the wonder and the majesty of what he does not understand. When thus perceived and practiced, and when not misused for ignoble ends, science and engineering are a major means for "making gentle the life of mankind." If science can thus appear in its true colors and thus be recognized, we will have accomplished a major requirement for attracting enough first-rate minds into science and for maintaining a vigorous and advancing technology.

Russian Engineering and Scientific Manpower

The present estimated backlog of about 540,000 engineers and 190,000 scientists in Soviet Russia is the result of a tremendous national effort to provide well-trained technical leadership for its changing economy. In 1930 the records showed about 41,000 engineers. Since then, the numbers in this one field have multiplied about tenfold. A feature of this expansion of technical manpower is the extent to which it is shared by women. About 20 per cent of all engineers are now women, perhaps 50 per cent of all professionals.

In 1954 Russia had some 890 universities and institutions of higher education, with an enrollment of 1,732,000 students. Many of these, as well as of the less-demanding technical institutions, are concentrated in three large cities: Moscow, Leningrad, and Kharkov.

The university graduating classes of 1954 included about 53,000 with a first professional or bachelor's degree in engineering, about 18,000 in agriculture, and 24,000 in the health and medical sciences. In addition, about 70,000 were graduated in education, and 8000 in several socioeconomic subjects such as the physical and biological sciences, and mathematics.

Engineers and scientists trained in Soviet institutions have many virtues and, except in detail, the education preparatory to granting the degrees is in no way inferior to that of holders of degrees from American universities and colleges. In the several fields of engineering and in chemistry, Soviet training is generally based on a larger number of instruction hours. Moreover, there is higher concentration on the major subject of study. This is accompanied by a reduced opportunity to select other subjects of a cultural or humanitarian nature. As a result, competent observers have expressed the opinion that Soviet engineers and scientists suffer a degree of overspecialization in comparison with those trained in the United States or in many of the European institutions.

All observers agree that Soviet textbooks are little more than compilations or manuals, and too frequently they fail to reflect recent scientific theories and discoveries. They are generally accepted by western educators as inferior to American university textbooks.

The Soviet student, like his counterpart in the United States, is subject to military service. However, deferments are general. As now administered, they serve as an effective means of allowing university entrance to only the most capable candidates. At the same time, the ever-present threat of possible military service provides a strong incentive for continued high standards of scholastic work.

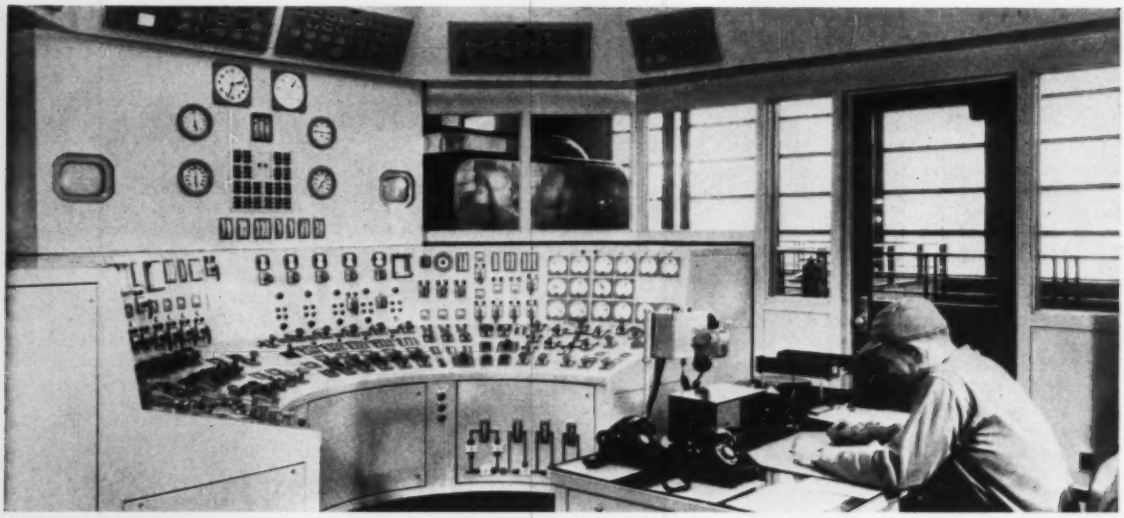
Secondary education is free, generally compulsory, and of a uniform character. School enrollment of about 30 million out of a total population of close to 200 million, has led to an estimate that attendance is available to no more than two thirds of the children of school age.

Mathematics, science, and the Russian language have top priority in all Russian secondary schools. General science has a lower place in requirements for advancement and, generally speaking, is more subject to the influence of Marxian philosophy. From "Engineering and Scientific Manpower in the United States, Western Europe, and Soviet Russia," Joint Committee on Atomic Energy, U. S. Government Printing Office, Washington, D. C., March, 1956. See also page 449 in this issue.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Associate Editor*



Over 350 instruments and controls keep the operators constantly informed of the operating conditions of the boiler, turbine-generator, and other auxiliary machinery at Burlington, N. J., Generating Station of Public Service and Gas Co.

200,000-Kw Turbine-Generator Unit

With the completion recently of a new 200,000-kw steam turbine-generator unit at Burlington Generating Station, located in Burlington, N. J., on the Delaware River, the New Jersey Public Service Electric and Gas Company has increased its capacity to 2,104,300 kw. The new unit costs approximately $31,500,000. See frontispiece, page 408, in this issue.

This new 200,000-kw unit has for its principal equipment a turbine-generator and boiler arranged in the unit system. The control room is located at turbine-floor level adjacent to the turbine and boiler. The new unit is operated with practically no ties, electrically or mechanically, with the old station. Space limitations dictated that the boiler be placed alongside the turbine. The coal pulverizers are placed in front of the boiler thus providing the shortest piping runs to the burners on the front of the boiler. The feeders of all pulverizers are accessible from one platform.

The new Burlington unit is designed for two-level operation, with the two levels 26 ft apart to conform to present turbine-room floors. The turbine-room extension is designed to be architecturally compatible with the existing turbine room. All parts of the boiler are out-of-doors except the burner area and the bottom of the furnace. The drum of the boiler is enclosed in the boiler casing, with a housing at each end.

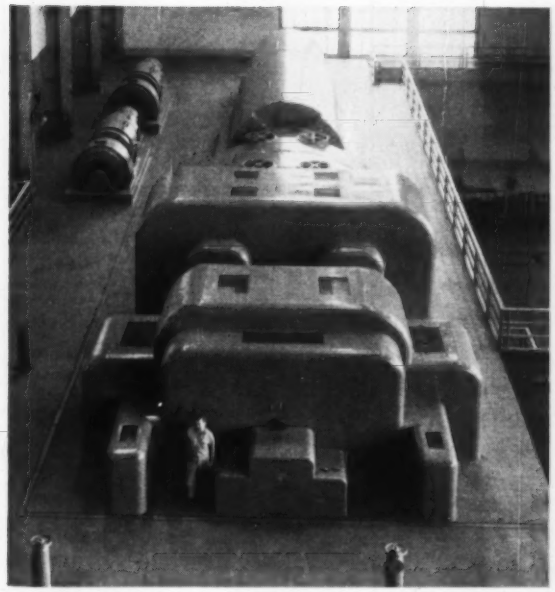
The feedwater-heating cycle includes eight stages of heating with six heaters and four drain coolers on the suction side of the boiler feed pumps.

Make-up for the unit is obtained by demineralizing the city water in a 50-gpm completely automatic mixed-bed unit.

Steam-Generating Unit

Features of the new Burlington reheat boiler include pressurized firing, flue-gas recirculation and tempering, and high steam temperatures and pressures. The capacity is 1,225,000 lb per hr continuous with a four-hour maximum rating of 1,350,000 lb per hr. The main steam temperature is 1100 F, and the reheat temperature is 1050 F. The superheater outlet pressure is 2389 psig. The furnace is of the wet-bottom type with continuous slag discharge. It is equipped to burn either coal or oil. The furnace is about 48 ft wide and 23 ft deep, and is divided by a waterwall which has large openings to equalize furnace pressure. Boiler efficiency is 91.17 per cent.

The high-temperature stage of the superheater, which is located at the exit of the furnace, has pendant tubes arranged in platens widely spaced to take advantage of radiant heat and to reduce fouling, as well as a closer-spaced pendant bank of convection tubes. The reheater and low-temperature stage of the superheater are ar-



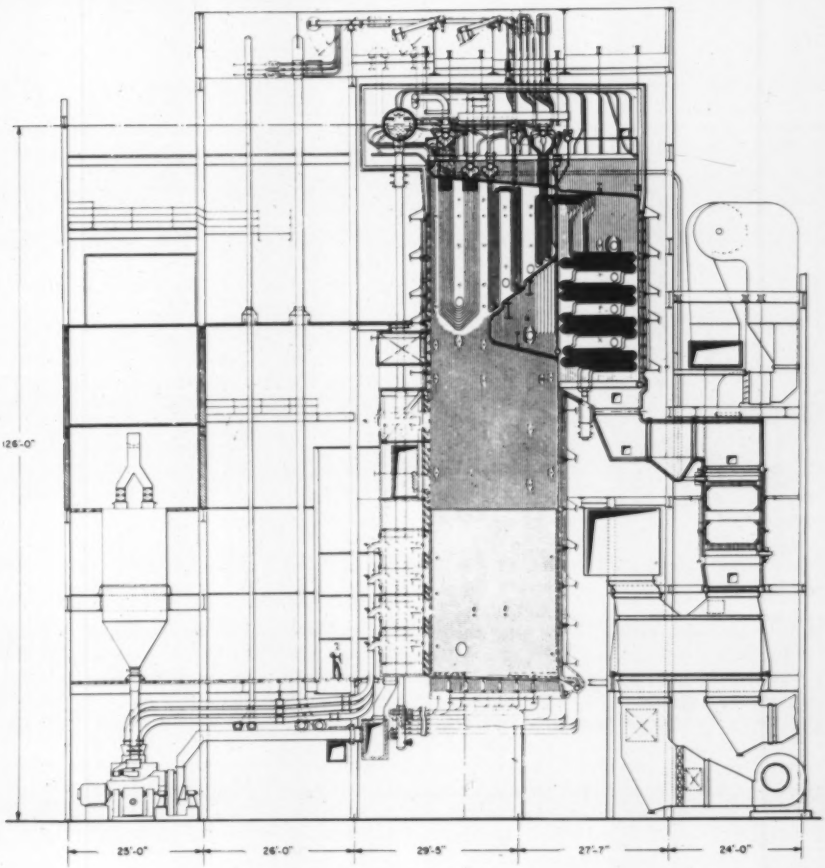
New 200,000-kw Westinghouse turbine-generator at Burlington Generating Station, the largest unit in service in the New Jersey Public Service Electric and Gas Company system, *left*

ranged in parallel in the gas passage with the low-temperature superheater on either side of the reheater. Both the reheater and superheater have a bank of pendant convection tubes, as well as four sections of horizontal tubes. The gas flow over these banks is regulated by dampers.

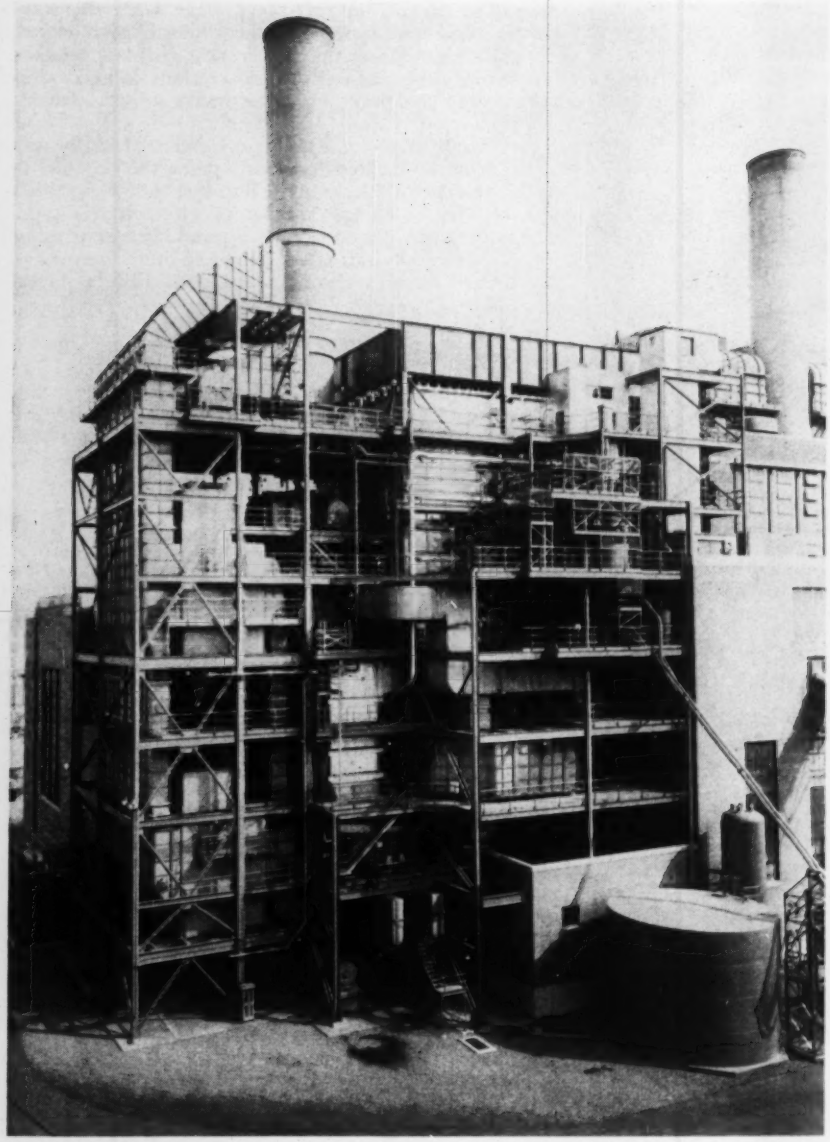
Next in the gas path is the economizer, and finally two Ljungstrom air heaters. At this point the flow splits as it enters the two decks of the flue-dust collectors which are of the combined mechanical-electrostatic type. The boiler normally operates as a pressurized unit, using only the forced-draft fans. Induced-draft fans have been provided to permit suction operation in emergencies.

Turbine-Generator

The turbine-generator operates at elevated steam conditions: 2350 psig, 1100 F at throttle, and 1050 F reheat temperature. It is a tandem-compound, 3600-rpm machine consisting of a high-pressure section, a reheat single-flow intermediate-pressure section, and a



Cross-sectional view of Babcock & Wilcox 1,225,000-lb per hr boiler



West elevation of Burlington Station unit showing semioutdoor boiler and double-deck precipitator

triple-flow low-pressure section. At these elevated temperatures, it is desirable to keep the amount of critical high-temperature materials to a minimum. This is accomplished by decreasing the heating of certain areas exposed to the hot inlet steam by using partially expanded steam as a coolant which is circulated over the exterior surfaces of the hot steam parts inside the outer casing before being exhausted to the reheater.

The turbine drives the main and auxiliary generators in tandem. The auxiliary generator supplies power for the normal operation of the unit's auxiliaries.

An automatic fine-fog spray fire-protection system is provided for the lubricating-oil reservoir, storage tanks, purification unit, and hydrogen detraining system.

Condenser

The divided water-box condenser has a surface of 80,000 sq ft. It is single-pass with the tubes parallel to the turbine axis. A single hot well is provided. Deaeration of make-up and drains is accomplished with deaerating trays in the main condenser. Fresh water from the Delaware River amounting to 121,400 gpm is used to condense the exhaust steam in the condenser.

Central Control

A soundproof and air-conditioned room is provided for all the controls of the new unit. The panel components are miniature and compactly arranged in a curved console. From his regular station the operator sees only the instruments that are necessary to operate the plant. Instruments for record purposes only are located in the wings of the control room. Telemetering is used extensively. Television apparatus is provided for viewing combustion conditions in the boiler.

High-Temperature Parts

The entire main steam system, from the superheater outlet header to the first-stage nozzle of the turbine, is made of austenitic stainless steel, chromium-nickel, columbium stabilized. This includes the main steam piping, turbine throttle valves, control-valve chests, inlet steam pipes, and a section of the inner high-pressure turbine shell. The main steam piping was made from seamless tubing. The materials of the superheater tubes, starting from the low-temperature end, are carbon steel, carbon-molybdenum steel, chromium-silicon-molybdenum steel, and chromium-nickel, titanium-stabilized steel.

The hot reheat piping is made of $2^1/_4$ per cent chromium—1 per cent molybdenum formed seamless steel. The materials of the reheater tubes of the steam generator, starting from the low-temperature end, are carbon-molybdenum steel, chromium-silicon-molybdenum steel, and chromium-nickel, titanium-stabilized steel. The tubes carrying the reheated steam outside of the furnace to the principal header are made of chromium-molybdenum steel.

Coal-Handling System

A unique feature of the unit is the coal-handling system which embodies an active outdoor bunker pile. The swing-boom conveyer makes it possible to place approximately 25,000 tons of coal in a kidney-shaped pile 60 ft high. Three 12-ft-diam conical hoppers located below grade under the ridge of this pile permit reclaiming approximately 4500 tons of coal. The pile over the hoppers can also be maintained by bulldozing from the coal-storage area surrounding the kidney-shaped pile.

The coal is automatically conveyed from the 4500-ton active pile to any one or all of five 50-ton silos, each of which feeds one coal pulverizer.

An automatic fine-fog spray fire-protection system is provided for the breaker and adjacent conveyers.

Ash and Dust-Handling Systems

The ash and dust systems are separate. The dust system is arranged so that the dust can be refired in the furnaces or sluiced by jetting to the disposal area. Facilities have also been provided for sale of dry bulk dust. The ash system includes facilities for jetting the slag to the disposal area so as not to contaminate the slag which is marketable.

Future Plans

To take care of growth in the immediate future, two new generating stations, at Linden and Bergen, N. J., are planned. Linden Generating Station is now under construction at Linden, on land adjacent to the Bayway Refinery of the Esso Standard Oil Company. The first installation will consist of two units of 225,000 kw each. They are scheduled for service in 1957. A unique feature of the new station will be the supply of large quantities of process steam to the Esso Standard Oil Company and, as a result, it will surpass in economy the most advanced high-temperature supercritical-pressure installations now being designed. The refinery will obtain its electrical power from Linden Generating Station and will supply the station with fuel and water.

Preliminary plans for the construction of Bergen Generating Station, in the Company's rapidly growing northern area, started late in 1955. The station site is located at Overpeck Creek and the Hackensack River, in Ridgefield, adjacent to the New Jersey Turnpike. Bergen Generating Station will have two generating units of 275,000-kw capacity each, and is scheduled for service in 1958.

On completion of the Linden and Bergen installations, the total effective generating capacity of the company's seven stations will approximate 3,000,000 kw.

OVEC Power Project

THE Ohio Valley Electric Corporation is now in full-scale operation well ahead of schedule.

OVEC recently announced the completion of its Clifty Creek Plant at Madison, Ind.—the world's largest privately owned power plant.

This announcement culminated the largest single undertaking in the history of the electric-utility industry: The construction and placing in operation of two major power stations, with generating capacity totaling 2,365,000 kw, and a 330,000-volt transmission network linking the two plants with the power systems of the sponsor companies and with the Atomic Energy Commission's Portsmouth (Ohio) Project.

The entire OVEC project, involving 15 private electric-utility companies of the Ohio Valley region and costing more than $385 million, was accomplished in the comparatively short period of three years and three months.

Operation of the last of Clifty Creek's six steam turbine-generators, originally scheduled for June, places all 11 of OVEC's 215,000-kw generating units in service. The remaining five are at Clifty's sister station, Kyger Creek Plant, Cheshire, Ohio.

Evaporograph

A UNIQUE instrument which makes it possible to see in the dark has been developed by Baird Associates, Inc., Cambridge, Mass., an affiliate of American Research and Development Corporation.

The device, which utilizes no electronic circuitry, is called an evaporograph (nicknamed EVA), and enables one to spot a man 200 yd away or to see a house a mile distant in total darkness.

Key to development of this instrument, originally designed for use by the armed services, is a basic principle of infrared radiation. Scientists know that different materials radiate varying intensities of infrared, depending upon temperature and surface. This radiation is present at all times, and can be detected from a distance of several miles.

In operation, the evaporograph is similar to a camera. The unit collects radiation emitted from an object and focuses it as an image onto an oil film. The oil then evaporates away from point to point at rates varying with the amount of radiation received at each point. Seen in reflected light, these differences in oil-film thickness appear as different colors, like oil films on water.

A detailed thermal picture of the field of view is thus obtained in color. This picture can be viewed directly or a photographic record can be made with a camera which is incorporated in the apparatus.

The unit is designed to observe radiation ranging from one to several thousand deg F, and features a sensitivity down to about two tenths of a degree. Accurate temperature measurements can be made either visually or photographically from this image.

EVA is housed in a cabinet 18 × 14 × 11 in. The infrared radiation enters through a lens on one side and the operator views the oil-film image through an eyepiece on the other.

To date, Baird Associates, Inc. has built about a dozen of these devices for the military, each at a cost of about $9500, including accessories.

The evaporograph presents a number of new areas of application in industry and research. Now it is possible to observe simultaneously temperatures over the entire surface of a process vessel or an electronic chassis. Furthermore, it is perfectly conceivable that one could peer inside a radio tube or look at the heat of a flame, and immediately learn exact temperatures in all parts of the scene being viewed. The evaporograph also holds

promise for the construction industry. A picture of a house in winter, for example, would indicate points where heat was escaping, and where insulation should be added.

Medically, the instrument is also interesting. The temperature differences over the surface of the human body are directly related to health. These differences can be seen in detail with the evaporograph, and the picture so taken has as much detail as a regular photograph.

Gas-Turbine Car

"The Turbine Special," Chrysler Corporation's experimental gas-turbine test car, has recently completed a successful 3020-mile cross-country endurance test.

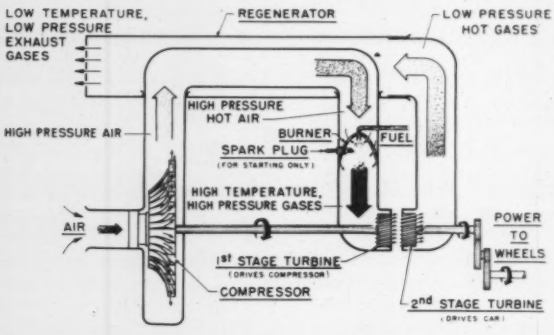
The research test car, a four-door 1956 Plymouth sedan, is a standard production model in every respect, except for the Chrysler-developed gas-turbine power plant under its hood.

Purpose of the test was to obtain technical data on how long and how well various vital components of the automotive gas-turbine engine perform in actual city and highway traffic, under various climatic conditions, at different altitudes, and on all kinds of grades.

Major Components of Gas Turbine

To perform efficiently the functions of an automotive power plant, Chrysler Corporation's gas turbine was designed with these main units: Air compressor, combustion chamber, first turbine for driving the compressor, second turbine for driving the car, and the regenerator.

The air compressor sucks in air and raises its pressure to several times atmospheric. In the process of compression, the air also rises in temperature. The high-pressure air flows to the combustion chamber where fuel sprays continuously and burns, heating the air to about 1500 F. This hot stream of compressed gas forces its way through the blades of the first turbine which rotates the air compressor, and then goes through the blades of the second turbine which is connected to the rear wheels to drive the car. At idle, the speed of the compressor turbine



Schematic diagram of Chrysler Corporation's experimental automotive gas-turbine engine shows how the regenerator unit (*top*) transfers heat from the exhaust gas to incoming fresh air on its way to the combustion chamber. The regenerator performs two important jobs: (1) Greatly reduces exhaust-gas temperature and (2) utilizes previously wasted fuel energy.

Looking over Chrysler's experimental gas-turbine engine, now installed in an otherwise "stock" model 1956 Plymouth, are James C. Zeder, *left*, vice-president, engineering, and George J. Huebner, Jr., Chrysler's executive engineer in charge of research. Mr. Huebner holds a power turbine wheel, duplicate of the one in the engine which supplies driving force to the car's rear wheels.

is near 20,000 rpm while that of the car-driving turbine is near zero (a situation comparable to the turbine of a torque converter). The car-driving turbine can rotate at speeds upward of 50,000 rpm. Of course this rotation must be geared down in the engine to a usable speed for driving the wheels of the car.

From the burner through the turbines, there is a drop in pressure of the gases to atmospheric pressure, but they retain large amounts of heat which would be wasted if merely allowed to escape through the exhaust pipe. So a regenerator for salvaging this heat is placed in the path of the outrushing gases. The regenerator recovers heat from the hot exhaust gases and transfers this energy to the high-pressure air coming from the compressor. This lightens the burner's job of raising the gas temperature for entry to the turbines. The result is conservation of fuel as well as lower exhaust temperatures. These are said to be the outstanding achievements of Chrysler's experimental gas turbine.

The turbine unit with its set of reduction gears is only 32 in. long, 33 in. wide, and 28 in. high. With fewer than one fifth as many major moving parts as in an internal-combustion engine, this turbine engine weighs about 200 lb less.

Performance

Chrysler's gas-turbine engine is rated at 120 shaft horsepower but it delivers about the same performance to the rear wheels as a piston engine rated at 160 hp connected with a transmission. The gas turbine enjoys freedom from several auxiliaries which are a drain on the horsepower output of the piston engine. Among those items missing are the cooling fan, the air cleaner, and the water pump.

The torque characteristics of the turbine should also

be noted in this performance comparison. The turbine's torque is greatest at breakaway from a standing position and falls off as car speed increases, when it is needed less. This contrasts sharply with the piston engine's torque which gradually builds from zero at the start to a maximum in the midspeed range. So a transmission is used with the piston engine to get torque characteristics approaching that of the turbine. Incidentally, a transmission is used in the present turbine test model only to provide a reverse gear. The car-driving turbine is in effect a built-in torque converter and is connected directly through gear trains to the rear wheels of the car.

The gas-turbine Plymouth is fueled with gasoline, carried in a standard fuel tank. However, a wide range of other petroleum fuels may be used, for example kerosene or heavy fuel oil. The fuel consumption, ordinarily very high for gas turbines, has been reduced to a level comparable with that of passenger cars. Scientific

Instrument panel of the 1956 Plymouth gas-turbine test car has been modified to suit the revolutionary new type of power plant that is under the hood. Replacing the familiar "oil-amp-gas-water" dials are such things as (*left* to *right*) the gas-generator speed indicator which registers up to 70,000 rpm (immediately above the steering column), compressor outlet pressure, fuel, turbine inlet temperature (rectangular face), engine oil pressure, oil-pump outlet pressure, and conventional speedometer.

studies indicate that further development work can make possible thermal efficiency as high as 40 per cent in a regenerative gas turbine. Passenger-car-engine thermal efficiencies at best conditions range from 24 to 27 per cent today.

Because combustion is continuous, the turbine delivers vibration-free power. The few moving parts rotate smoothly on ball or roller bearings.

Auxiliary Units

The gas turbine's electrical system consists of a storage battery, starter-generator, coil, breaker, and a single spark plug. To start the car you turn the key as you do in your present car. This starts the starter motor which turns the compressor. When the compressor speed increases part way to the idle speed of 20,000 rpm, the fuel (ignited initially only by the spark plug) will continue to burn and help the starter motor bring the compressor up to operating speed. At this point the circuit switches and the starter motor serves as a generator to charge the battery.

Production

Although installed in and operating a production car, the automotive gas turbine is still an experimental engine. Much development work is still ahead. Also, to challenge the piston engine, which has undergone about one-half century of development, is quite an undertaking. So a definite time cannot be stated for the appearance of the automotive gas turbine on the American market.

Gas-Turbine Boat

THE "Solar Meteor," a revolutionary gas-turbine-powered boat, recently recorded a speed of 26 knots during a demonstration in San Diego, Calif. This speed is more than double the rate of comparable boats with conventional engines.

A joint project of the U. S. Navy Bureau of Ships and Solar Aircraft Company, the Meteor is a standard 40-ft Navy personnel boat specially fitted with Solar's 500-hp Jupiter engine. It is said to be the most powerful gas turbine ever installed in a Navy boat.

It is hoped that the Meteor, which will be used as a floating laboratory to evaluate gas-turbine propulsion of small vessels, will yield data making possible new types of high-performance craft for military and civilian applications.

The engine is a Solar Model T-522J variable-speed Jupiter gas turbine, weighing about 1000 lb, including reduction gearing to propeller speeds. Despite its high output, the engine is small and compact, less than one fourth the weight of a comparable marine diesel engine. In the variable-speed or free-power type of turbine, it is possible to vary the power output of the engine without affecting the compressor speed, thereby offering significant advantages in applications such as motive power. In the Solar Jupiter, two stages of the three-stage turbine drive the compressor unit, while the third stage drives the power output shaft.

The 500-hp Jupiter is about 6 ft long and both height and width are roughly 3 ft. It employs a 10-stage axial-flow compressor and a 3-stage axial-flow turbine. The rotor turns about 20,000 rpm.

The Solar Meteor, a Navy personnel boat powered by Solar Aircraft Company's 500-hp Jupiter gas-turbine engine, is shown on a shakedown run in San Diego Bay

Three-Stage Rocket

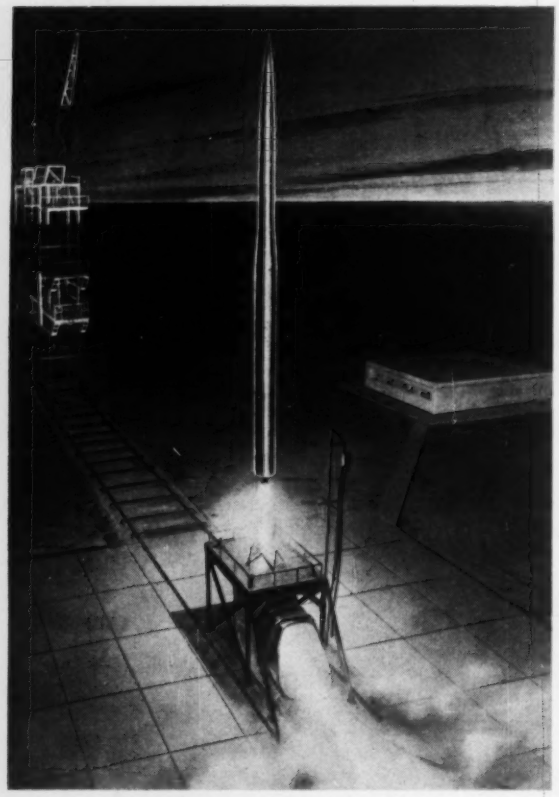
PRELIMINARY flight details of the Vanguard three-stage rocket vehicle being designed and built by Martin to place the world's first man-made satellite in its orbit, have been released by the U. S. Navy and the Martin Company of Baltimore, Md.

The satellite launching vehicle will resemble a giant rifle shell complete with bullet. It will be the first liquid-fuel rocket designed to be controlled without the use of fins.

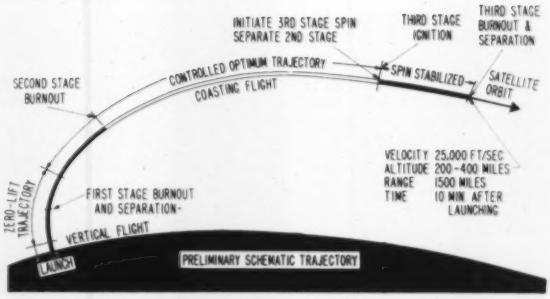
The 45-ft-long first-stage rocket resembles the Navy Martin Viking research rocket which attained an altitude of 158.4 miles, a world's record for a single-stage rocket.

The second-stage rocket, mounted above the first stage, has a cone-shaped nose section. It also uses liquid propellants. The third-stage rocket, with the satellite attached to its nose, will be carried completely enclosed within the second-stage rocket. The third stage uses a solid propellant because of its simplicity.

The first stage, which launches the entire assembly, will burn out its fuel at an altitude of between 30 and 40 miles. Then it will separate and drop off.



Artist's conception of the Navy Martin Vanguard research vehicle which will place the world's first man-made satellite in its orbit around the earth. This is part of U. S. participation in the International Geophysical Year, 1957–1958. It is supported by the three services with the management of Project Vanguard in the hands of the Navy. The vehicle will be launched from Air Force Missile Test Center, Cocoa, Fla. In the background is the gantry used to place the vehicle on its launching stand; and the concrete blockhouse from which scientists will fire the rocket and record its course.



Drawing of the trajectory of the Navy-Martin Vanguard research vehicle, depicting burn-out positions of the three stages of the vehicle in its flight to place a satellite in its orbital altitude of between 200 and 400 miles above the earth

The second stage will start firing, and at a certain time during the second stage, burning will jettison its nose streamlining, leaving the third stage and the satellite exposed.

The second-stage rocket will tilt in the direction of the satellite's predetermined flight path. After its burnout, the second stage will continue to coast upward until it attains the satellite's intended orbital altitude.

There a spinning movement will be imparted to the third-stage rocket to insure directional stability. By that time the third stage will be set on its course; the second stage will drop off; and the third stage will start firing.

The third-stage rocket carrying the sphere has no guidance system, no electronic brain to direct its flight. Its job is to boost the satellite's speed to approximately 18,000 mph. This high speed, necessary to counteract the earth's gravitational pull, will be attained at the rocket's burnout.

At burnout, the satellite may be nudged ahead by means of a releasing device in the nose of the rocket. Therefore its speed will be slightly greater than that of the rocket shell, which will not drop to the earth, but will trail the satellite until atmospheric drag causes both gradually to slow down and spiral toward a lower atmosphere.

Through friction induced by passing into this denser atmosphere, both satellite and rocket will burn briefly and disintegrate after the manner of meteors.

The Martin Company is prime contractor for the Vanguard launching vehicle. General Electric Company has a contract with Martin for the rocket motor to be used in the first stage, which is an advance of the Viking rocket built for the Navy. The Aerojet-General Corporation of Azusa, Calif., has a Martin contract for the second-stage propulsion system, which consists of a liquid-rocket motor and its associated fuel tanks and pressurizing system.

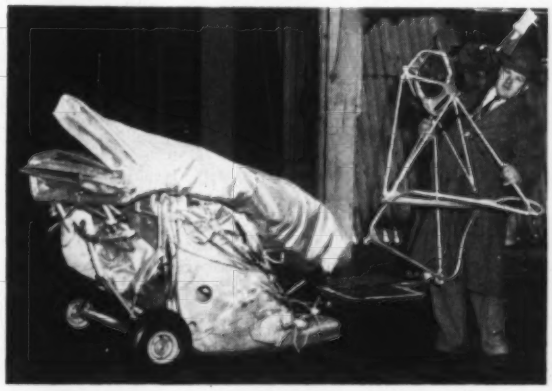
Contracts for the third-stage rocket have not been announced yet.

Inflatable Airplane

AN INFLATABLE airplane that can be deflated and packed in the trunk of the family car has been flown for the first time at Goodyear Aircraft Corporation, Akron, Ohio.

Designed and developed by the company to test the

possibilities of rubberized Airmat fabric as structural material for aircraft, the lightweight plane is made rigid by air pressure.



With wing and tail assemblies deflated and folded neatly over the inflated seat section, remainder of Goodyear Aircraft Corporation's inflatable airplane, the engine, and its tubular support, is shouldered by Engineer Roger L. Wolcott

Lightweight monoplane of rubberized Airmat fabric made rigid by air pressure is taken aloft during tests at Wingfoot Lake Airship Base, Akron, Ohio. Goodyear Aircraft Corporation developed the craft to test the possibilities of Airmat as structural material for aircraft

Wing, tail assemblies, and pilot's seat are made of Airmat material, a Goodyear Tire & Rubber Company product consisting of joined layers of inflatable rubber-coated nylon fabric shaped by thousands of droppable pile threads. The craft's conical-shaped fuselage is made of airship fabric.

Inflated, the plane resembles a glider with the pilot seated at the front of the ship. Deflated, it can be packed in a trunk. Less air pressure than that required to inflate passenger-car tires is needed to pump up the plane.

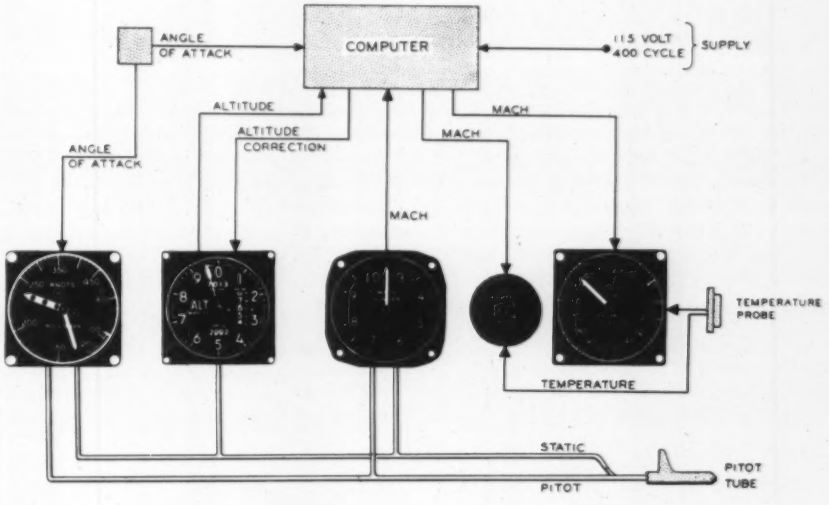
The single-place high-wing monoplane has a two-cycle, 40-hp motor mounted on a tubular support above the fuselage directly behind the wing. Only other metal support connects the wheels and pilot's seat with the fuselage. High-strength fan-shaped patches of rubberized material are used to attach the various members, struts, and other supports.

Goodyear Aircraft designed and built the inflatable plane in a little more than 12 weeks. It is the first of its kind in the United States. Until further development is complete, disclosure of additional information is not contemplated by the manufacturer. Quantity production is not planned.

Flight-Instrument System

Development of an integrated flight-instrument system, a new concept in flight efficiency, safety, and control, has been announced by Kollsman Instrument Corporation, Elmhurst, N. Y. For the first time air-line pilots are given interrelated flight data which are said to be more precise and more complete than any available to date. The system features greatly increased altimeter accuracy to provide precision in altitude separation. Douglas Aircraft Company, Inc., have announced their acceptance of the instrumentation for use in the DC-8 aircraft.

The important advantage of the system is that it depends on conventional pressure instruments which are connected electrically to each other and to a computer but which can function independently. By means of the electrical connections, standard indications are made considerably more accurate and new information is



Integrated flight-instrument system developed to give air-line pilots interrelated flight data

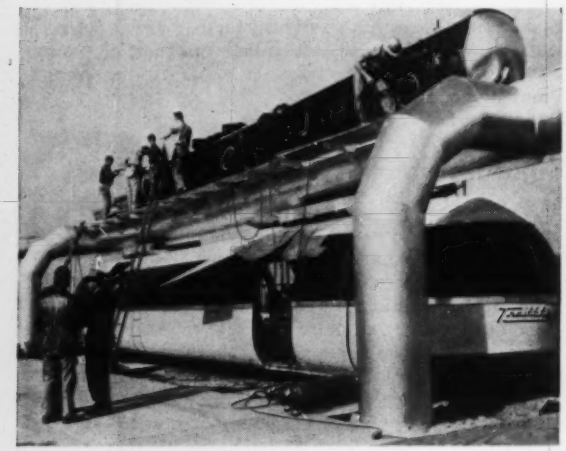
secured. In the event of electrical interruption, the pilots continue to receive pressure readings so that indicated and maximum allowable air speed and Mach number are not affected, while altimeter indication reverts to its normal pressure accuracy.

The nucleus of the system is an altimeter which has a new high accuracy with realistic errors of not over 50 ft at sea level and 100 ft at 40,000 ft. The Machmeter, corrected for installation error, gives continuous indications of Mach number throughout the range of the aircraft. In addition to indicated and maximum allowable air speed, the air-speed instrument gives data previously unavailable to air-line pilots—minimum safe speed for approach and landing, and most efficient cruising speed. True air speed, and true outside air temperature employed in detecting and flying the jet streams, are also presented.

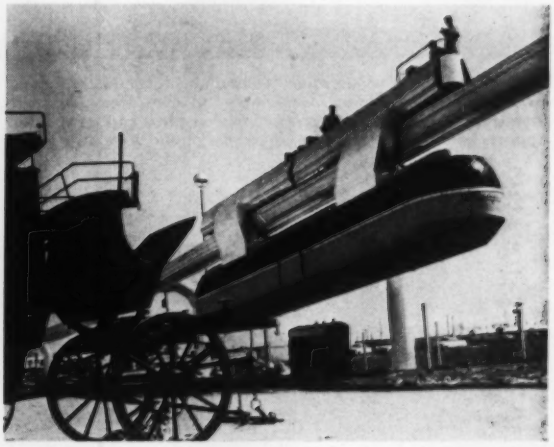
tion in Wuppertal, Germany. Known there as the "schwebebahn," meaning the "floating car," the system has carried more than 900 million passengers during the past 53 years without a fatal accident.

Adaptable to cities of any size with transportation problems, the monorail can travel aloft, on the surface, or underground. It can be used for short specialized trips, long intercity travel, or for speedy nonstop commuter service. Cars, with 60–90 passenger capacity, can run singly or coupled in train fashion.

The 54-ft-long blue steel-ribbed coach is almost completely encased in fiberglas and solar glass. With its eight 8.25-15 Traction Hi-Miler tires carrying the load and providing the traction and another series of twenty 4.00–8 rib trailer tires serving as guide tires, the coach travels the rail virtually noise and vibration-free. It is powered by two 305-hp gasoline engines.



Workmen are shown installing Goodyear 8.25-15 Traction Hi-Miler tires as they ready the "power nacelle" unit of the Trailblazer coach for its first trip along Houston's new Skyway monorail. A series of 4.00-8 rib trailer tires serve as guide tires. The power nacelle also houses two 305-hp engines, interlocking wheels, and auxiliary steel wheels. New scientific principles embodied in the design make it impossible for the coach to overturn or to "jump the track."



Framed against a stagecoach from a past era, the suspended Trailblazer coach of the new Houston Skyway monorail glides along underneath the single overhead rail pointing its way toward a possible new age of transportation. A group of Houston engineers and businessmen are operating the 970-ft test pilot line at the city's Arrowhead Park to demonstrate the monorail's practicality as a safe, economical, and speedy means of urban and interurban transportation.

Overhead Monorail Transit System

A SUSPENDED passenger coach gliding along underneath an overhead rail in Houston, Texas, may provide the answer to automobile traffic congestion and the problems of mass transportation.

This new rapid-transit pilot system, the Skyway monorail, is being operated in the city's Arrowhead Park by a group of Houston engineers and businessmen to demonstrate its practicality as a safe, economical, and speedy means of urban and interurban transportation.

Over a 970-ft freeway, an oval-shaped 50-ft coach, equipped with 28 pneumatic tires built by The Goodyear Tire and Rubber Company, moves along a single steel rail that is suspended 18 ft over the ground by a series of inverted J-shaped towers, 30 ft high. Although limited to moderate speeds by the short rail length, the car can travel at high speeds on a full-scale line.

The Houston Skyway monorail is an improved version of the suspended-coach system now in full-scale opera-

Future monorail systems are expected to be integrated with existing transit systems, thereby stimulating their use, according to Murel Goodell, president of Monorail, Inc. of Houston. Simple to maintain, the overhead railway is also inexpensive to build, costing approximately $500,000 a mile on a full-scale line, as compared to $4–6 million for freeways and $12–14 million for subway construction.

Civilian Atomic Power Plants

DECISION by the General Electric Company and the Pacific Gas and Electric Company to build and operate an atomic power plant to serve the San Francisco Bay area, has been announced by the Atomic Energy Commission.

To be financed entirely by private capital, the plant will be located in the Livermore-Pleasanton area of Alameda County, Calif.

The plant is expected to be completed during 1957 at a cost of between $3 million and $4 million. Initially, the plant will have a maximum generating capacity of 5000 kw, and an ultimate capacity of 10,000 kw or more.

This brings to 15 the number of civilian atomic power plants under construction, in process of design, or proposed in the United States, for completion during the period between 1957 and 1962. These plants involve a total expenditure of over $500 million and industry is prepared to meet approximately half of this cost. As presently proposed, the 15 plants will have a total generating capacity of nearly 1-million kw of electrical power.

A nuclear reactor of the boiling-water type will be used by the General Electric and Pacific Gas and Electric Company plant. The experimental reactor facility will be constructed and operated at the General Electric Company's new atomic laboratory near Livermore.

The atomic power plant being built at Shippingport, Pa., by the Duquesne Light Company and Westinghouse under the Commission's experimental power-reactor program also is scheduled to be completed next year. It will provide the Pittsburgh area with 60,000 kw or more of electricity.

Eight of the 15 proposed power plants will be built by private industry and seven are projected by public groups, including co-operatives.

The General Electric-Pacific Gas and Electric plant is the fourth power reactor to be proposed by industry under the straight license provisions of the law, whereby such plants are financed entirely by private funds, without any request for direct Government financial aid.

The other three projects in this category are: Consolidated Edison Company, which will build a plant at Indian Point, N. Y., using a pressurized water reactor and having a generating capacity of 140,000 kw; Commonwealth Edison Company, which will build a 180,000-kw plant of the boiling-water type at Dresen, Ill.; and the Pennsylvania Power and Light Company which has indicated its intention to build a 150,000-kw plant in Eastern Pennsylvania with a homogeneous-type reactor. The Commonwealth and Consolidated plants are scheduled for completion in 1960 and the Pennsylvania plant in 1962.

The four atomic power plants to be financed entirely by industry represent private investment of approximately $150 million.

Industry is also planning to build three large-scale atomic power plants, each with a capacity of 75,000 kw or more, under the Commission's Power Demonstration Reactor Program. Industry will bear the larger portion of the cost, or about $110 million. The Government will invest about $55 million to advance the technology of civilian power production.

The three large-scale plants, for which industry will bear the major part of the costs are: Yankee Atomic Electric Company, a 134,000-kw pressurized water-type reactor at Rowe, Mass., Power Reactor Development Company, Inc., including Detroit Edison Company and others at Monroe, Mich., a fast-breeder reactor, generating 100,000 kw; Consumers Public Power District of Nebraska, a sodium-graphite reactor with a 75,000-kw capacity.

In addition to these eight plants, scheduled for completion between 1957 and 1962, seven public groups have recently submitted proposals for construction of smaller plants—2000 to 40,000-kw capacities—under the Power Demonstration Program. The Commission presently is studying the seven proposals. They are: Rural Cooperative Power Association, Elk River, Minn., boiling-water reactor, 22,000 kw; University of Florida, Gainesville, Fla., pressurized water reactor, 2000 kw; City of Piqua, Ohio, organic moderated reactor, 12,500 kw; Wolverine Electric Cooperative, Hersey, Mich., aqueous homogeneous reactor, 10,000 kw; City of Orlando, Fla., liquid-metal-fueled reactor, 25,000 to 40,000 kw; City of Holyoke, Mass., gas-cooled reactor, 15,000 kw; Chuqach Electrical Association, Anchorage, Alaska, sodium heavy-water reactor, 10,000 kw.

The 15 projects for civilian atomic power plants are in addition to the Commission's own experimental civilian power-development program, designed to expand the technology of eight different concepts of power reactors. The Shippingport plant is being constructed under this experimental program. Ten other individual reactor projects are included, three of which are scheduled to be completed this year including the sodium-cooled reactor being built for the Commission at Santa Susana, Calif., by North American Aviation. The heat produced by the Santa Susana reactor will be sold to the Southern California Edison Company and converted into 7500 kw of electricity for civilian use.

Engineering and Scientific Manpower

A RATHER comprehensive and detailed survey of the problem of a shortage of trained engineering and scientific manpower has recently been completed by Melvin Price, chairman, Subcommittee on Research and Development of the Joint Committee on Atomic Energy. Entitled "Engineering and Scientific Manpower in the United States, Western Europe, and Soviet Russia," the report presents an extremely interesting study of the rate and types of advanced scientific degrees being granted at the present time by academic institutions as well as the past history of the awarding of such degrees. The report was issued by the U. S. Government Printing Office, Washington, D. C.

According to Mr. Price, the United States is in desperate danger of falling behind the Soviet world in a critical field of competition—the life-and-death field of competition in the education and training of adequate numbers of scientists, engineers, and technicians. But although it is not a secret, the facts have not sunk into the public mind.

Many warnings have been issued, many speeches have been made. They have been reported. But they have not sunk into the mind of the administration and the Congress, even when the warnings came from eminent administration sources. Mr. Price suggests that the time has come for strenuous measures, for action by the Government, by business corporations, and universities, for what might be called a "crash program" to increase swiftly and steadily the number of adequately trained American scientists and engineers.

The Russians, Mr. Price reveals, ever since their 1917 revolution, have put constantly increasing stress on the education of competent technicians, including topflight scientists and engineers, to sustain their drive for industrialization and a truly modern military machine. We have indulged in laissez-faire policies, ignoring the decline of interest among high-school students in mathematics and basic science, offering no incentives to univer-

sity students to turn themselves toward the fields of technical study in which we need experts to sustain our place in the world.

Mr. Price pointed out that we are scarcely even with the Soviet Union as regards numbers of engineers and have only a slight lead in numbers of scientists. From here on, the Russians show promise of widening the difference—and to our disadvantage. In 1954 we graduated only half as many college-trained specialists in engineering and science as we did in 1950. In the same year the Soviets turned out more than twice as many as we. Allen Dulles, Director of the Central Intelligence Agency, recently warned that in this present decade the Soviet Union will graduate 1,200,000 university students in the basic physical sciences while we will graduate only 900,000.

Qualitatively, the work of the Russians in pure science, applied science, and engineering has always been of high character. It would be a major blunder to imagine that the Soviets lag behind us as abstract thinkers about the universe or as practitioners of theories, Mr. Price states. The Russians blunder when they insist on a doctrine of genetics that temporarily appears to suit communist dogma. They don't commit blunders in building a hydroelectric project or a bridge, in mass-producing a swift jet bomber, in testing their nuclear weapons, and building their stock pile.

Our problem is what to do about the situation. The facts show that we must do something quickly, that we must not simply wring our hands, and talk about the dangers. The dangers are immediate and real. There is a startling correlation between a nation's industrial power and standard of living—and therefore its strength in self-defense—and the size and quality of its reservoir of trained scientific and technical manpower.

Mr. Price suggests that the Federal Government must take the initiative. Who or what else can? A decisive Federal program can stimulate the co-operation needed from all sectors of our national life.

One way to emphasize Government determination to meet the requirements would be to appropriate Federal funds to expand the science departments and engineering schools of the universities and to provide scholarships for bright young high-school graduates willing to enter these fields. This is a prime requisite, he points out.

Mr. Price states that he recognizes that the question of general Federal aid to schools is a controversial subject. However, he notes, since it is a constitutional Federal function to provide for the common defense, Federal spending is proper to provide enough well-trained engineers and scientists to sustain our security in an age of great scientific "breakthroughs."

Give well-qualified high-school boys and girls the assurance that they have a chance for university education and good professional careers, and they will turn their attention to preparatory courses they need in the science field. High-school and college teachers will gain encouragement from the fact that the Government recognizes the importance of their work. There will be more such teachers and more students will flock to their classes.

Recognition of an imperative need by the Government would encourage corporations, alumni groups, and individual philanthropists or foundations to sustain the effort.

According to Mr. Price, many corporations are already giving a limited number of scholarships in science to likely boys and girls in high school. The help-wanted columns of our newspapers are crowded with pleas for competent technicians, capable of intricate and rewarding work in keeping the nation well prepared with modern weapons of defense. The trend can be stimulated by proper Federal action and by evidence that the Federal Government means more than lip service in talking about our need for a great increase in our scientific and engineering manpower.

The emphasis must be on Federal leadership because nothing else will do, Mr. Price declares. Only the Federal Government has the resources and prestige to produce a swift new emphasis on the training of an adequate number of qualified young people in the engineering and scientific fields.

Fail-Safe Monitoring Systems

SUCCESSFULLY tested on fire-detection systems, machine safety controls, furnace flame monitors, photocell intrusion alarms, and liquid-level controls, a new dynamic monitoring technique, which checks itself by a unique pulsation method, has been developed by the Scully Signal Company of Melrose, Mass. Invented by William G. Rowell, Scully chief engineer, this new Scully-Rowell fail-safe method requires few additional components to change conventional static systems to the new dynamic self-checking design. The technique is sufficiently basic to be used with electronic, electrical, mechanical, pneumatic, hydraulic, and nuclear systems.

Fields of application include burglar and fire protection, industrial and home-heating control, railroad, aircraft and safety systems, process-control instrumentation, and a multitude of miltary and atomic-energy protective systems.

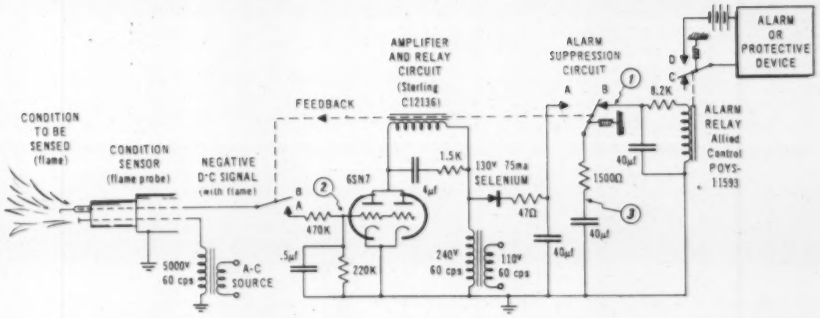
Equipment protective devices and system monitors incorporating the Scully-Rowell method continually check themselves by periodically simulating the dangerous (unsafe) condition they are designed to detect. If the protective monitor responds properly to this simulated danger, it is sure to respond to the real danger when it occurs. An alarm suppression circuit is built into the monitor to hold off the warning signal during the short period of simulated danger.

The simulated unsafe condition is introduced periodically into the monitor, resulting in a continual safe-unsafe-safe-unsafe . . . . . oscillation which holds the alarm off. Failure of the safe condition being sensed or of the monitoring system itself halts the required safe-unsafe oscillation and sounds the alarm or initiates corrective action.

Any number of examples of this dynamic perturbation technique may be used to illustrate the unique Scully-Rowell method. A photocell circuit designed to detect the absence of light is tested by periodically interrupting the light beam. A temperature monitoring system is tested by pulsing a heat source in the vicinity of the temperature detector. A nuclear radiation monitor can likewise be tested by periodically exposing a radioactive source near the sensing element. The operability of a float-type liquid-level monitor can be proved by sinking the float every few seconds with a solenoid-actuated plunger.

The safe-unsafe oscillation of the system may be caused by a free-running perturbation device at the monitor input, or by the use of feedback to produce a

Self-testing industrial controller is inspected by its inventor, William G. Rowell, *right*, of the Scully Signal Company and Edward A. DuBois, *left*, Supervisor of Building Services for Polaroid Corporation. This fail-safe furnace flame monitor, consisting of a torch unit held by Rowell and a panel-mounted circuit being checked by DuBois, has tested its own performance millions of times by a unique pulsation method.



Simple schematic of Scully-Rowell fail-safe flame monitoring system—condition sensor output is modulated by use of feedback

relaxation oscillation within the monitoring system. The period of oscillation can be adjusted to meet the requirements of the particular control system, and may range from hours to microseconds.

Leading manufacturers of industrial-control equipment are now adapting the technique to commercial systems. A Scully-Rowell fail-safe oil-burner controller has completed 15 months of continous trouble-free operation at the Polaroid plant which makes the famous Polaroid-Land Camera film. During this period, it has checked itself over six-million times to prove its safe and proper operation.

High-Titanium Carbide

A NEW tougher, easy-to-grind, high titanium carbide with nickel binder which promises to improve tool life in precision finishing and boring of steels is reported by Carboloy Department of General Electric Company, Detroit, Mich.

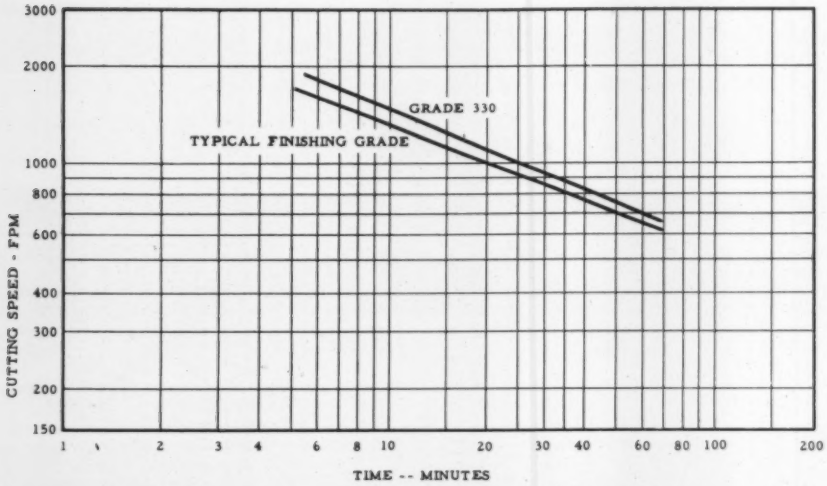
Tests show the new carbide to be much tougher than carbides normally employed for finishing steel and, although it is not quite as hard as cobalt binder-type carbides, it is equally wear-resistant.

Its transverse rupture strength is about 200,000 psi with hardness about 91.5 Rockwell A. This is almost twice the strength of commonly used finishing carbide grades with hardness less than two points lower on the Rockwell A scale.

The new composition, called grade 330, also can be easily produced consistently to provide a uniform structure. In the finishing area of machining, the new addition takes up where grade 350 leaves off, to round out Carboloy's line of 300 series carbides.

Due to its structure and added toughness, the new carbide is less susceptible to chipping or cracking than currently available finishing carbide grades during brazing, grinding, or in use. It can be ground easily on duplicating-type grinders and, if accidently crowded while grinding, it will not crack readily.

When used as a brazed tip, however, the new carbide



Tool life line comparing new Carboloy grade 330 carbide for precision-finishing steel with typical finishing carbide in use today. Tests were conducted on AISI 1045 steel hardened between 160 to 170 Brinell, without coolant. Tool life was based on 0.030-in. flank wear with feed set at 0.002 in., depth of cut 0.015 in. Tool geometries: 0 deg back rake, 6-deg side rake, 7-deg relief angles on side and end, 15-deg end cutting-edge angle and 45-deg side cutting-edge angle.

requires the use of a special flux to provide proper wetting. According to Carboloy engineers, a silicon-bearing-type flux used with generally available, lower-melting-point, high silver solders provides satisfactory results.

An indication of the new carbide's toughness was revealed dramatically in one of several field tests. During this particular test the carbide was employed as a profile turning tool in machining SAE 1117 steel hydraulic valve lifters. For test purposes the job was being run at various speeds—between 225 to 750 fpm, with the valve lifters being loaded and unloaded automatically.

Sometimes during the test the work was not fully chucked. This created a terrific work load on the cutting tool. But instead of breaking, the carbide tool was merely shoved back into the toolholder post. Previous carbides, under similar conditions, broke instantly. By resisting chipping or breakage in this particular test the new Carboloy grade 330 provided a tool life better than three times that of any carbide used previously for machining the lifters.

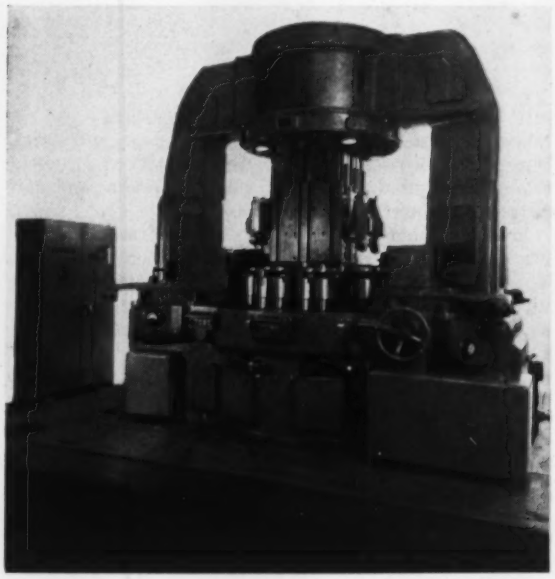
Vertical Automatic Chuckers

A SERIES of new Acme-Ryder vertical multiple-spindle hydraulic chucking automatics was announced recently by The National Acme Company, Cleveland, Ohio. Design of the machine is based upon that of Thomas Ryder and Son, Ltd., Bolton, England.

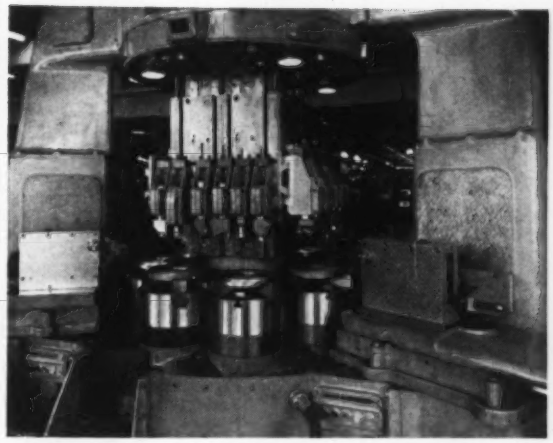
First of the new series is an eight-spindle model equipped with 14-in. capacity chucks, eight turning slides, and four cross slides. In addition, four "auto cross slides" can be operated on the vertical turret at one time to provide greater tooling adaptability for production-machining of large forged and cast workpieces. A six-spindle model, equipped with 17-in. capacity chucks, six vertical turning slides, and four cross slides also will be available.

The cross slides complement the vertical end-working slides and provide flexibility and additional tooling operations heretofore not available in a single machining setup in these capacities. Because the independent cross slides of the Acme-Ryder are mounted on the lower frame and actuated from cam drums located directly beneath them, they provide maximum support for the heaviest forming cuts as well as cross-facing or necking operations on the surface of the piece.

Standard spindle-speed range is 32 to 628 rpm. Three spindle speeds are available at each spindle position with



14-in. Acme-Ryder eight-spindle vertical hydraulic chucking automatic



Rear-side tooling view of 14-in. Acme-Ryder eight-spindle vertical hydraulic chucking automatic with double indexing performing 26 operations to complete both ends of a cast-iron flywheel in one machining setup in 43 sec total machine time

each set of pick-off gears providing satisfactory speeds for various cutting requirements.

Positive indexing of the spindle carrier is by an independent indexing motor with hydraulically operated locking and clamping at completion of index. Changeover from single to double index (or vice versa) is accomplished quickly by the removal or addition of a cam on the indexing tappet shaft.

Functions performed hydraulically include: Opening and closing of chucks; engaging and disengaging clutches in the spindle drives; applying brakes at the loading stations; providing a reverse motion of the carrier to bring it back against the locating catch after indexing, then actuating a wedge to hold the carrier in that position; and clamping the carrier during cutting.

Machine controls are conveniently located near the loading station and are duplicated at the rear for ease in setting up. A master timing cam drum controls the completely automatic machining cycle, operating switches for the entire electrical circuit including the electrohydraulic circuits.

Weight of machine without tooling is approximately 60,000 lb.

Air-Conditioning Research

THE amount of winter heating or summer cooling lost by traffic through building entrances is the subject of a new research project by the American Society of Heating and Air-Conditioning Engineers. The program will be conducted at the ASHAE Research Laboratory in Cleveland, Ohio.

According to Elmer R. Kaiser, Mem.ASME, ASHAE director of research, it is expected that the results of this program will be of particular importance to manufacturers of doors, building owners, and managers, and heating, ventilating, and air-conditioning engineers.

The program, which will require a minimum of two years, is to be conducted in two phases involving laboratory work and field tests in a number of cities, Mr. Kaiser said.

The field tests will be made to record the traffic through entrances of various types of buildings at different times of the day including peak rush hours. Large and small, multistoried, and one-story buildings will be tested. Motion-picture cameras and indicators above the doors will be used to record the precise amount of door opening at each fraction of a second. Simultaneously, sensitive instruments will measure the pressure differences across the entrances, because the amount of door opening affects the stack effect.

The measurement of air flow cannot be done easily in the field, continued Mr. Kaiser, and for this reason the tests will be confined to a wind tunnel in the ASHAE Research Laboratory. This will provide for accurate measuring of air flow which can be related to that experienced with actual building entrances. The model tests will include single doors, multiple doors, and vestibules in a variety of combinations.

With the information from the field and laboratory tests compiled in suitable tables, practical estimates of air flow under various conditions will be possible.

The Engineer Looks at Management Positions

(Continued from page 429)

instruments such as operational analysis and statistical control methods. He has recourse to planned methods to stimulate creative engineering. He has at his beck and call an impressive bibliography in all kinds of fields related to business administration, personnel handling, and so on.

What does all this add up to? It means not only that there is a much greater variety of supervisory engineering jobs, but that many have become a great deal more technical. The "bull of the woods," who gained his position because of aggressiveness and canny "feeling" for the business, is a vanishing species. His place is being taken by a much more intellectual type of engineering supervisor who understands today's technology and who is able to inspire teamwork.

It is typical of the present large corporations that many supervisors are "middlemen." While being part of management they in turn are responsible to higher levels of management. They must be able to give and take. Such large corporations offer to talented young engineers a variety of opportunities which often were denied them in the smaller family-controlled business of years gone by.

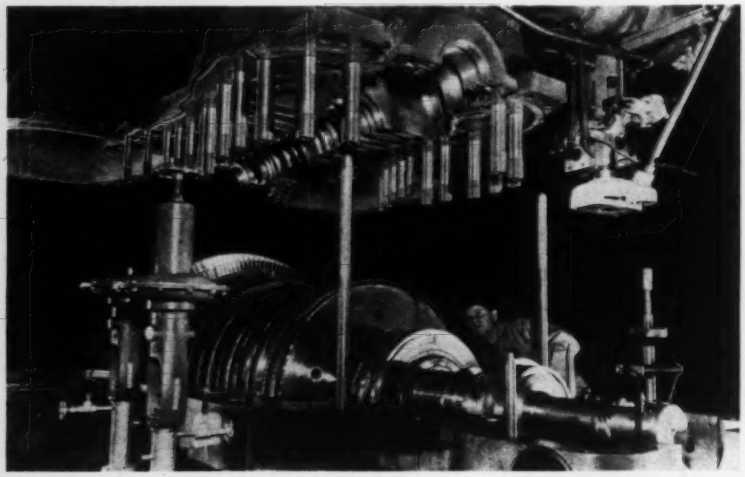
Today's Opportunity

What does the engineer see when he looks at management positions?

He sees an increasing diversity of positions from which to select according to his aspirations and his capabilities.

He observes that, particularly in a company which fosters management development, he will have opportunity to prepare himself to enter management.

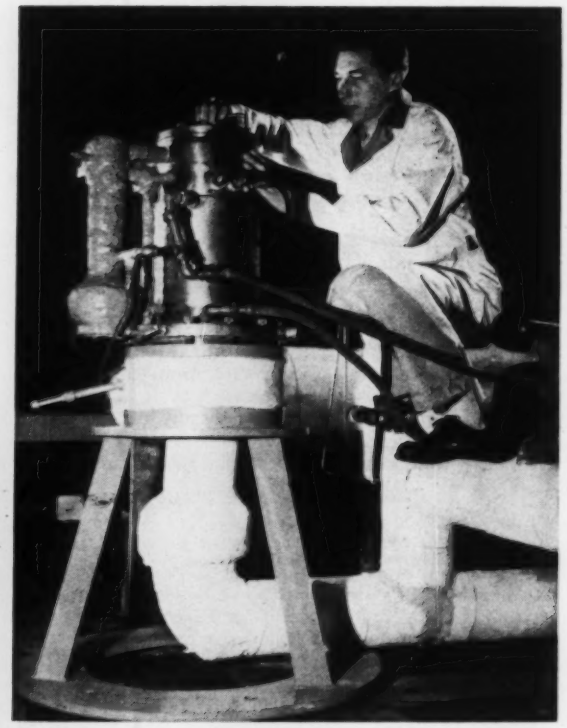
If he is technically inclined he finds that there is an increasing number of management positions in which technical talent is a prime requisite.



Nuclear Plant Steam Turbine. Shown during final assembly at Allis-Chalmers West Allis Works is this 5000-kw steam turbine for the Argonne National Laboratory's experimental boiling-water reactor power plant. The turbine is of modified design to provide for exceptional leak-tightness required for steam coming directly from the reactor. Grooves can be seen on lower surface and special glands of the upper half casing. In service, the inner groove will be evacuated continuously, while the outer groove carries dry air under pressure. Thus any outward steam leakage will be evacuated and can be reclaimed if desirable, while any inleakage will contain no air-borne moisture derived from "ordinary" water. This latter feature is important while the plant is operating on heavy water.

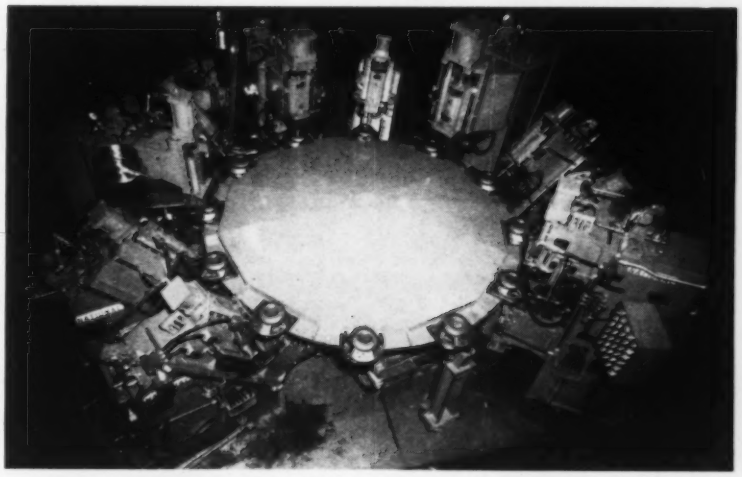
Engineering Developments . . . at a glance

Heat-Resistant Fiber. Fiberfrax rope, ***below***, a new product of The Carborundum Company, takes the heat of a blow torch and the pull of a weight without damage. The high heat-resistant Fiberfrax rope can take temperatures as high as 2300 F and keep its form and properties. A new form of ceramic fiber, the rope is easily installed as expansion-joint packing and high-temperature wrapping, gasketing, and sealing.



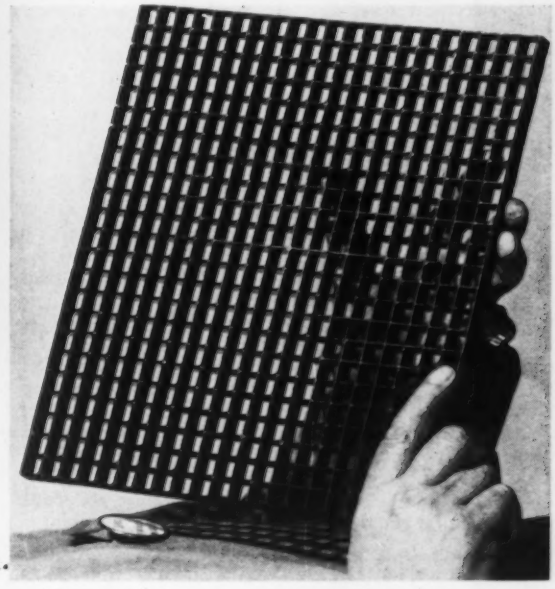
Liquid-Metal Pump. This mechanical liquid-metal pump, ***above***, built by the Westinghouse Atomic Equipment Department, has just completed a successful 500-hr performance test run at more than 1000 F—the highest temperature at which a pump of this type has ever operated for an extended period. It is rated 150 gpm at a 285-ft head. The new mechanical (centrifugal) pump has a hermetically sealed "canned-rotor" which contains pump and motor rotor in one integral unit. Production models of the pump will operate up to 1600 F.

Resistance Welding Machines. National Electric Welding Machines Company, Bay City, Mich., has recently completed and shipped to one of the country's leading manufacturers of electric refrigerators this highly automated grouping of 10 resistance welding machines. The machines all operate simultaneously on ten separate parts and locate and weld connecting fittings and bushings to the upper shell of a refrigerator compressor. One operator loads and unloads the shell and all other parts are automatically selected and placed in welding position from hopper feeds and other types of automatic loaders. The large plate holding the compressor shells is 100 in. in diam and indexes every 10 sec, moving each shell between the welding dies on each separate welding machine.



Gyroscope Check-Out. Sensitive gyroscopes, ***above***, heart of a new supersonic autopilot developed by Minneapolis-Honeywell, are put through a "wobble" test. The gyro's drift rate, as charted on the firm's electronic recorder in the background, must be less than 0.35 deg per minute. Minneapolis-Honeywell is building the autopilots under a recently announced $7,715,377 United States Air Force contract, part of an over-all $15 million order for the autopilots for use in U. S. Air Force jet aircraft.

Transition-Molding Process. New transition-molding process developed at Northrop Aircraft, Inc., produces this complex grid, ***below***. It is made of epoxy resin by a three-stage molding process. Cost of parts made this way is only four per cent of the cost of producing machined aluminum parts of the same type. An original female mold is milled from a block of Cerrobend; an epoxy-resin master is cast in this mold and removed by melting the alloy. An elastomer is then poured around the master part to produce a flexible mold. Many parts may then be cast, regardless of draft angles or undercuts. The parts hold to a tolerance of ±0.002 in. and possess all desired characteristics.



European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

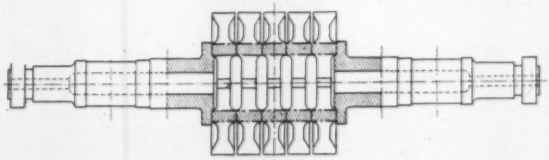
Interior view of Malgovert hydroelectric station, France, part of the Tignes project, which comprises a dam—at present the tallest in Europe—at Tignes and power stations at Brévières and Malgovert. (Photo copyrighted by Electricité de France.)

Generator-Rotor Construction

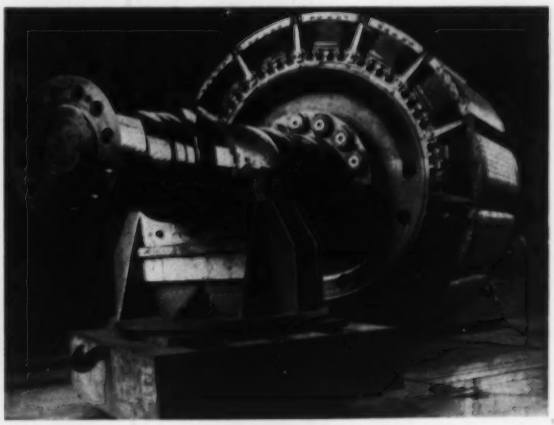
At a meeting recently held in London jointly by the Institution of Structural Engineers and the British Section of the Société des Ingénieurs Civils de France, a paper on the Tignes hydroelectric scheme, in the French Alps, was read by Monsieur R. Giguet, Director of Equipment, Electricité de France, in which he gave some interesting details of the method of constructing the rotors of the four 108,000-hp alternators installed in the Malgovert power station. Each of these generators is driven by two single-runner double-jet Pelton turbines, which are claimed to be the most powerful machines of this type ever made; the flow to each runner is 7.2 cu yd per sec under a gross head of 2450 ft. The normal speed is 428 rpm, with a permissible overspeed up to 770 rpm. The over-all length of the rotor is 10 meters (33 ft) and the diameter, without the poles, is 3 meters (10 ft).

To forge and machine a one-piece rotor of such dimensions was impracticable, as the ingot weight would have been some 300 tons and it was felt that the risk of rejection was too great; and fear of excessive stresses ruled out the alternative method of shrinking a succession of forged disks on a single shaft of the length required—a solution which incidentally would have required the fitting of a removable coupling at one end of the shaft, since it was to be driven from both ends. It was decided, therefore, to use two short shafts with large flanges at their inner ends, between which to bolt the five forged-steel disks. There being 14 poles, 14 alloy-steel tie rods were used, hot-bolted through the disks so that they were prestressed when cold. The factor of safety is such that every alternate rod could break without endangering the rotor.

The turbines were the joint production of the Etablissements Neyrpic, at Grenoble, and the Creusot steelworks. The situation of the Tignes project in the upper



Cross section of generator rotor for Malgovert hydroelectric station showing method of construction



Completed generator rotor, which weighs 204 tons, in the works of the makers, La Société Alsthom. (Photo copyrighted by Electricité de France.)

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

valley of the river Isère, and about 60 miles southeast of Geneva, introduced its own difficulties in the transport of such heavy loads by road, especially as the road was crossed by a number of railroad bridges; one bridge had to be raised 4 ft 3 in. and then replaced on eight occasions to allow the four stators and four transformers to pass. Before the rotors were built, two series of experiments were carried out with geometrically similar models to test the rigidity of the proposed construction and to determine the critical speed, which was found to be 1230 rpm. Each rotor is carried in two plain bearings, ring-oiled (four rings) and cooled by water pipes buried in the Babbitt metal.

Reconstructing a Steel-Melting Shop

THE largest cold-metal steel-melting shop in Europe is the Templeborough plant at Rotherham, England, of Steel, Peech and Tozer, Limited, which is one of the firms comprised in the United Steel Companies combine. This shop, a quarter of a mile long, contains 14 open-hearth furnaces which have been reconstructed over the past three years, without interrupting production, to give an increase in output of 35 per cent.

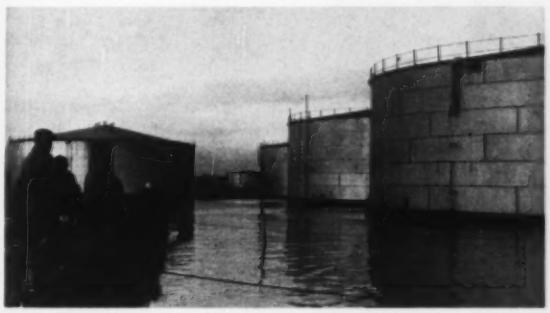
Initially, each of the furnaces was of 80 tons capacity and in 1952, the last full year before reconstruction began, the production totaled rather more than 594,000 ingot tons. One by one, the furnaces were taken out of service, the old brickwork stripped out, and linings of a modified form constructed to increase the capacity from 80 to 100 tons. The average time taken to reconstruct each furnace, from tapping the last melt to relighting, was about nine weeks, including the installation of new straight-through Blaw-Knox valves with single checkers. The enlarged furnace hearths are 25 in. thick and consist of a 1-in. layer of firebrick laid on the steel plates, followed by 12 in. (four courses) of Dolofer refractory brick and 12 in. of rammed dolomite. Each furnace now has a bath capacity of 484 cu ft. Nine of the furnaces are oil-fired, four run on creosote pitch, and one is maintained on producer gas for experimental purposes. On the four normally using creosote pitch, fuel oil can be used as an alternative if required.

The shop works 21 shifts per week and 12 furnaces are in operation at any one time, the remaining two being down for routine maintenance. The last of the rebuilt furnaces went into service again in February of this year. It is estimated that the loss in steel production while the conversion was in progress was only a quarter of 1 per cent over the three-year period; and, of course, total production rose steadily as each furnace went back into service on a greater capacity. The output went up to more than 729,000 tons in 1955 and is expected to top 800,000 tons in 1956.

Previously the shop had been served by four 100-ton ladle cranes in the casting bay, but the increased volume of steel and slag from the larger furnaces made it necessary to replace these with 150-ton cranes, which involved a complete renewal of the crane-track girders. As the furnace conversions proceeded, the new cranes were erected in succession and the old cranes dismantled, so that the increasing crane capacity always kept pace with the increased output. The new cranes have 25-ton auxiliary hoists, air-conditioned control cabins, and telephone communication with the pouring floor. The crane-track girders are all-welded and weigh 16 tons each. The top flange plate is 2 ft 2 in. wide, the bottom flange plate 2 ft wide, and the depth of the girder 5 ft $3\frac{1}{4}$ in. The total weight of new steelwork in the crane tracks is 1350 tons. Altogether, the conversion project required 3000 tons of new steelwork and the setting of nearly 10 million refractory bricks.

Shifting Oil Storage Tanks

AN UNUSUAL "lifting and shifting" job arose at the Stanlow, England, refinery of the Shell Petroleum Company, where ten large oil tanks, each of 9000 tons capacity, were obstructing an expansion scheme. Conditions on the site, and the new locations of the tanks, made it necessary to use three methods of removal. Though they are 118 ft in diam and 40 ft high and weigh about 300 tons empty, four of the tanks were skidded on rail tracks for 500 yd to their new site, the motive power being provided by diesel-driven trucks. Another tank, which had to be shifted 1300 yd, was cut into sections and rewelded on its new foundation. The remaining five tanks were floated along a specially constructed canal, 500 yd long, filled by pumping 24 million gal (about 29 million U. S. gal) from a nearby small river, eight diesel-driven pumps being used. This gave a depth of water of about 3 ft 6 in., which was ample to float the tanks with about 18 in. clearance. Each tank in turn was then hauled by teams of men to its new position. Tractors were kept in reserve in case wind pressure took a tank out of control. Frogmen located the tanks in their exact positions, where they were "anchored" by dropping lengths of steel pipe into the water while the flooding valves were opened. When all five tanks had been shifted and secured the canal was drained and its walls demolished, leaving the ground clear for future extension of the refinery.



Oil storage tanks being moved by floating along a specially constructed canal at Shell's Stanlow oil refinery, Cheshire, England

Fifth World Power Conference

THE delegates who attend the Fifth World Power Conference, to be held in Vienna, Austria, from June 17 to June 23, 1956, are promised a strenuous week; the latest list enumerates a total of 260 papers in the 18 sections which make up the program of the technical sessions. Thirty-five member nations are taking part.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Hydraulics

Some Aspects of High-Suction Specific-Speed Pump Inducers, by C. C. Ross, Mem. ASME, and G. Banerian, Mem. ASME, Aerojet-General Corporation, Sacramento, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-124 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

Some aspects of the design and performance characteristics of high-suction specific-speed pumps (cavitating inducer) are discussed. Although conventional pump-suction specific speeds are limited by incipient cavitation limits, the properly designed cavitating inducer can operate at values of suction specific speeds many times that limited by incipient cavitation.

It was concluded that almost all of the inducers tested have had the inlet area obstructed by 10 or 15 per cent by the impeller blades. The effect on performance resulting from impellers with fixed values of inlet-area obstruction and with one or more blades has not been evaluated completely. Neither has the effect on performance been completely determined resulting from varying the number of blades with the same value of solidity. The range of solidities tested has been from 2.5 to 3.5, with the ratio of length of inducer to diameter varying from 0.4 to 0.6. No optimization with respect to the foregoing parameters has been performed.

There is definite evidence that an outside shroud reduces the maximum suction specific speed obtainable from inducers. Apparently the flow over the impeller tips tends to unload the blades in the region of most severe cavitation. This also suggests the possibility that holes or slots in the blades in cavitation areas may permit blade unloading or even provide a fluid cushion against the blade surface against which the cavitation bubbles may collapse.

Scale factors of 2 or 3 do not materially affect over-all performance in the range tested, but for much larger scale differences, performance may be affected by the actual time required for the formation and collapse of the cavitation cavity.

The head developed by the inducer or impeller at each section definitely affects performance, since rapid turns, etc., can cause low local pressures and possible separation.

The Design of Axial-Flow Pumps, by R. D. Bowerman, Assoc. Mem. ASME, California Institute of Technology, Pasadena, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-127 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

A design procedure for axial-flow pump impellers is presented that accounts for induced interference effects in the prediction of performance. Induced interference velocities at an impeller blade have been calculated using a three-dimensional model that includes the effects of the other blades and of the total downstream vorticity along the center line of the pump.

The design method considers improvement of cavitation conditions by specifying the radial variation of the design parameters such that the pressure distributions on all radial sections are similar. An analysis of optimizing the impeller geometric parameters for cavitation conditions is presented to permit the initial choices of the quantities appearing in the design procedure. Experimental work on a two-bladed impeller has yielded results that give good support to all aspects of the design method.

Turbulence and Boundary-Layer Effects on Cavitation Inception From Gas Nuclei, by J. W. Daily, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass., and V. E. Johnson, Jr., National Advisory Committee for Aeronautics, Langley Field, Va. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-142 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

The inception of cavitation in a liquid medium is dependent on a variety of hydrodynamic and nonhydrodynamic effects which complicate the problem of scaling. Cavitation occurs in zones of low pressure hydrodynamically produced by flow relative to the boundaries. It is well known that changes in flow rate and size will modify the local hydrodynamic conditions, although the exact role of boundary-layer growth and associated turbulence on local pressures is not understood completely. In addition, it has been observed that cavitation inception is not always reproduced at the same hydrodynamic conditions, but seems to depend in some way on the physical properties and states of the liquid, the solid boundaries, and the entrained solid and gaseous matter.

The investigation in progress at the M.I.T. Hydrodynamics Laboratory is directed at the general problem of scale effects in cavitation inception. The initial experiments have been concerned with the influence of boundary layers and turbulence on the pressure of cavitation inception and the location of inception relative to the solid boundary. The study necessarily has involved the role of gas bubbles as nuclei for cavitation and the interrelation of the stability of small gas bubbles, their size and space distribution, and the velocity and pressure variations in the turbulent boundary layer. This paper is a discussion of this combination of factors.

Critical Considerations on Cavitation Limits of Centrifugal and Axial-Flow Pumps, by Dr. G. F. Wislicenus, Mem. ASME, The Pennsylvania State University, University Park, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-144 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

This is the presentation of a problem, not of its solution. A critical examination of the cavitation problem of centrifugal and axial-flow pumps indicates that such pumps are operated at higher speeds than can reasonably be expected to exclude cavitation or local pressures below the vapor pressure of the fluid pumped. This fact is revealed by relating the over-all cavitation characteristics of pumps for which empirically determined values are available to detailed characteristics usually described as blade-pressure coefficients which are backed not only by empirical but also by theoretical information sufficient for a rational interpretation of present data and for an estimate of future developments. The practical significance of this

fact is discussed and the possibilities for further advancements are investigated, including pump operation with fully developed cavitation.

Suppression of Pump Vibrations Set Up at Starting Up—Preopening Method, by F. Numachi, Institute of High Speed Mechanics, Tôhoku University, Sendai, Japan. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-145** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

Cases occur in large water pumps, wherein, after installation, vibrations exceeding allowable limits are found to set in when starting up, and as a measure to meet such situations without resorting to reconstruction of the pump itself, a method of "preopening" is presented in this paper, which consists of opening up the delivery valves to a certain extent while the pump is gradually being worked up to full speed.

The method of estimating the quantity of reverse flow, the torque required, and the time necessary for attainment of normal speed is explained. An example of application in actual practice is further given.

Hydraulic-Turbine Runner Vibration, by R. M. Donaldson, Mem. ASME, Newport News Shipbuilding & Dry Dock Co., Newport News, Va. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-130** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

This paper describes an investigation of the vibration characteristics of Francis turbine runners and some experiments to determine the influence of different shapes of runner-bucket discharge edges on the excitation forces. Modifications suggested by the experiments were made to field runners and were successful in eliminating some objectionable vibration.

The Slotted-Blade Axial-Flow Blower, by Dr. H. E. Sheets, Mem. ASME, General Dynamics Corporation, Groton, Conn. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-156** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

An analysis is made for the application of boundary-layer control to the blades of axial-flow blowers. The design of the slotted blade extends laminar flow over a larger portion of the blade chord and simultaneously permits large flow deflections. Blowers with slotted blades offer thus the possibility to design for higher efficiency or higher pressure ratio, or possibly a combination of both. The slotted blade permits a considerable increase in pressure coefficient or corresponding operation at lower tip speed for a given pressure increase. Design data for the slot geometry are discussed. Test data of an experimental blower are presented demonstrating efficiencies to 94 per cent with flow deflection of about 52 deg at the hub. The effect of solid or slotted guide vanes and the diffuser on blower performance are shown. A variation in slot geometry is tested. The blower has a maximum stage efficiency of about 96 per cent.

Closed Systems for Testing Compressors, by R. M. Johnson, Mem. ASME, Ingersoll-Rand Company, Phillipsburg, N. J. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-157** (multilithographed; available to Oct. 1, 1956).

The closed system is discussed in its broad applications to the shop-testing of centrifugal and displacement compressors. The essential requirements for the design and operation of test systems to use various gases are reviewed. Instrumentation and procedures necessary to meet the ASME Power Test Codes standards of accuracy are considered in detail. Suggestions are made for code revisions needed to bring closed-system testing more fully within the scope of the test codes.

Metal Processing

Heat Transfer to and Temperature Distribution in a Metal-Cutting Tool, by D. L. Rall, Assoc. Mem. ASME, Detroit Controls Corporation, Redwood City, Calif., and W. M. Giedt, Assoc. Mem. ASME, University of California, Berkeley 4, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-217** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

An analytical and experimental investigation of heat transfer to and the resulting temperature distribution in a metal-cutting tool during orthogonal cutting is described. A rectangular parallel piped-shaped tool is postulated and a product solution developed for the temperature distribution under the conditions of a continuous uniform release of heat over the tool-chip contact area and heat loss from each side arbitrarily specified.

To test the validity of this solution two high-speed lathe tools with 0 to 15-deg back rake angles were uniquely instrumented with thermocouples located in the tool bodies at selected distances from the cutting edges. Representative temperature records obtained during dry orthogonal cutting of SAE 1020 steel with these tools are presented. Extrapolation of temperature measurements to the center of the tool-chip contact area gave values for the average tool-chip interface temperatures which agree quite closely with results of other investigators. Average heat rates to the tools are determined and the applicability of the product solution is discussed.

Some Studies of Angle Relationships in Metal Cutting, by J. H. Creveling, University of California, Berkeley, Calif., T. F. Jordan, Technishe Hochschule, Hannover, Germany, and E. G. Thomsen, Mem. ASME, University of California, Berkeley, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-125** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

Free-cutting steel, SAE 1113, in the annealed, and SAE 1113 and SAE 4135 in the cold-rolled condition were studied in orthogonal metal cutting. The feed was varied from 0.002 to 0.010 in. per revolution (ipr) and the rake angle from 20 to 40 deg, at a surface speed of 30 fpm, using several cutting fluids. This range of rake angles and feeds was in the practical region and permitted obtaining of continuous chips. When examining the current theories on the shear angle ϕ, rake angle α, and friction angle β relationships, it was found that none was in complete agreement with the experimental results.

It appears that at this time the knowledge of the theory of plastic deformation as applied to metal cutting is insufficient to allow derivation of a unique theoretical solution which incorporates all variables. However, the equation $\lambda = \phi + \beta - \alpha = \text{const}$ was found to hold approximately for the limited range of variables investigated. It was further found that the friction process on the tool face can be explained satisfactorily as a metal-shearing process, and that the ratio of the shearing stresses on the shear plane and tool face was approximately constant for the experimental data obtained.

Influence of Grinding Fluids Upon Residual Stresses in Hardened Steel, by H. R. Letner, Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-123** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

Grinding fluids perform functions which might be expected to affect the

residual surface stresses resulting from a grinding operation. Stresses were analyzed in bars of hardened ball-bearing steel, surface-ground in the presence of thirteen different fluids. The results suggest that the effectiveness of a fluid in minimizing residual grinding stresses depends not so much upon its capacity for removing heat from the surface as upon its ability to reduce frictional forces between the wheel and the work.

Although the wheel, feeds, speeds, and work material used are typical of conditions to be found in commercial practice, no claim of generality beyond the scope of the present experiments is made for the following conclusions.

1 Stresses obtained with water solutions of rust inhibitor or miscible oils differ very little from those resulting from dry grinding.

2 Some reduction in magnitude of the peak tensile stresses is indicated by certain straight grinding oils.

3 Straight grinding oils are conducive to high compressive stresses very close to the surface.

4 The effectiveness of a grinding fluid, as far as residual stresses are concerned, depends upon its ability to reduce thermal and mechanical stresses during chip formation, rather than upon its ability to carry heat away from the cutting zone after it has been generated. That is, in terms of the generally recognized functions of grinding fluids, lubrication is more important than cooling.

Lubrication

Temperature Distribution in the Journal Bearing Lubricant Film, by M. B. Purvis, Assoc. Mem. ASME, Bell Telephone Laboratories, Whippany, N. J., and T. C. Benton, The Pennsylvania State University, University Park, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-216** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THE equations for the adiabatic temperature distibution in the journal bearing are obtained for both the infinite bearing and the short bearing. The solutions are obtained by treating viscosity and density as functions of temperature. The solution shows that the lubricant temperature increases as it flows through the bearing and that the temperature rises as long as the film remains continuous. Since the film becomes discontinuous shortly after the point of minimum film thickness, the point of minimum film may be taken as the point of maximum temperature. A numerical example showing comparison with experimental data is presented.

The Maximum Temperature Profile in Journal Bearings, by O. Pinkus, Assoc. Mem. ASME, General Electric Company, W. Lynn, Mass., and B. Sternlicht, Assoc. Mem. ASME, General Electric Company, Schenectady, New York. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-212** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

AN expression for the circumferential temperature distribution in the midsection of a journal bearing is derived which in implicit form presents temperature as a function of angle, with bearing geometry and operating conditions as parameters. This relation is obtained from an analysis of the energy balance between shear losses and heat storage in a hydrodynamic journal bearing under the assumption that no heat is lost to the surroundings. A discussion is given on how to locate the maximum temperature in bearings of common design.

Heat Transfer

Cooling of Glass Molds, by Rudolf L. Wille, Hermann Foettinger Institute, Technical University, West Berlin, Germany. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-65** (multilithographed; available to Oct. 1, 1956).

THE cooling of glass molds of bottle machines is conventionally done by blowing air over the outer surface of the mold. Experiments at the running machine proved that the air-jet energy can be lowered considerably when using "spines" on the surface of the mold. Furthermore, the new system of "evaporation cooling" has been investigated in theory and in experiment. Dosed quantities of water drops are applied to locally concentrated "heat sinks" at the outer surface of the glass mold It could be proved that periodical heat transfer to boiling water is an economical way of mold cooling. Finally, experiments are described studying the effect of liquid sodium in hollow molds.

Mean Temperature Difference in One, Two, and Three-Pass Crossflow Heat-Exchangers, by R. A. Stevens, Assoc. Mem. ASME, and J. R. Woolf, Assoc. Mem. ASME, Convair, A Division of General Dynamics Corporation, Fort Worth, Texas. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-90** (multilithographed; available to Oct. 1, 1956).

A REVIEW is presented of the mean-temperature-difference equations for all previously solved cases of crossflow exchangers. A numerical integration procedure was used to obtain data for the single-pass unmixed case. The 10 unsolved cases of two and three-pass countercurrent crossflow exchangers also were solved by numerical integration. Design data in the form of correction factors are presented for all cases not previously solved.

Instruments and Regulators

Hydraulic Power Steering—Effects of Valve Characteristics and Steering-Wheel Inertia, by W. E. McCarthy, Assoc. Mem. ASME, and W. A. Van Wicklin, Ford Motor Company, Dearborn, Mich. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-64** (multilithographed; available to Oct. 1, 1956).

THIS paper discusses the dynamics of a hydraulic steering system for passenger automobiles. The automatic feedback-control system is outlined in detailed block-diagram form. Each element of the system is briefly described without mathematical derivations.

Two blocks of the system are more closely examined. The steering-wheel inertia has an important effect on the reversibility of the system. This is shown in a block diagram and by experimental test data. System damping resulting from the hydraulic control-valve characteristics and the relations between steering-wheel velocity and output are described

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Procedures for Evaluation of Control-Valve Mechanical Characteristics, by J. T. Ward, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., and Otto Kneisel, Hamel-Dahl Company, Providence, R. I. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-105** (multilithographed; available to Oct. 1, 1956).

THIS paper lists and describes briefly the procedures commonly used for evaluation of control-valve mechanical characteristics. The paper deals with both those tests performed during manufacture as intermediate checks and also the proving evaluations of tests made after the valve is completed and assembled.

A name has been chosen arbitrarily for convenience in referring to each class of evaluation to be covered. These names are listed in the order in which they are discussed. (*a*) Casting and forging inspection, (*b*) dimensional and concentricity gaging in manufacture, (*c*) stem-finish evaluation, (*d*) pressure rating of topworks, (*e*) diaphragm testing, (*f*) maintenance of spring rate and dimension tolerances, (*g*) topworks leakage tests, (*h*) pressure rating of valve body (*i*) hysteresis testing, (*j*) port leakage testing, (*k*) checking of valve travel, (*l*)

check for stability at a given pressure drop.

Sonic Pneumatic Measurements of Lengths and Their Applications, by A. L. A. Fortier, University of Paris, Clamart/Seine, France. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-111 (multilithographed; available to Oct. 1, 1956).

AIR gages are nowadays extensively used in production. These gages, owing to the remarkable properties of sonic flows, permit measurement of lengths with a high degree of accuracy and reliability. The air gages, making use of sonic flows and of the principle of the pneumatic Wheatstone bridge, are, in addition, particularly well suited for automatic machine-tool controls.

Some Hydrodynamic Aspects of Valves, by F. F. Ehrich, Assoc. Mem. ASME, Rolls Royce, Ltd., Derby, England. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-114 (multilithographed; available to Oct. 1, 1956).

FREE streamline-potential flow analysis is used to analyze the flow regulation in two-dimensional configurations approximating the flapper valve, the needle valve, the orifice-plate valve, the gate valve, the butterfly valve, and the spool valve Experimental data are reported which evaluate the accuracy of some of the derived expressions and also evaluate the possibility of applying the results to three-dimensional axisymmetric configurations.

Results are presented in tabular and graphical form. An analysis is also carried out to evaluate the dynamic forces on the moving element of a flapper valve resulting from the motion of the fluid. Equivalent spring force and damping force are detected as well as some unstabilizing influences of negative damping and negative apparent mass. General descriptions of the origin of these forces are also given.

Test Procedures for the Evaluation of Control-Valve Flow Performance, by C. M. Johnson, Mem. ASME, Fisher Governor Company, Marshalltown, Iowa, and J. M. Fallis, Standard Oil Company, Indiana, Whiting, Ind. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-152 (multilithographed; available to Oct. 1, 1956).

DIFFERENT methods have been used to establish ratings for the maximum capacity and flow characteristics of control valves. These methods and the equipment used are described. It is pointed out that the use of different methods will result in differences in valve ratings. The necessity for standardized procedures for testing and rating control valves is discussed.

Machine Design

The Influence of Shank Area on the Tensile Impact Strength of Bolts, by J. Love, Jr., Assoc. Mem. ASME, General Electric Company, Cincinnati, Ohio, and O. A. Pringle, Assoc. Mem. ASME, Columbia, Mo. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-77 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THE effect of reduction of shank cross-section area on the tensile impact strength of 5/16, 3/8, and 7/16-in. steel bolts was investigated experimentally. Low-carbon 3/8-in. bolts with rolled threads absorbed maximum impact energy when the ratio of shank area to thread-root area was equal to 1.23. Heat-treated medium-carbon 3/8-in. bolts absorbed maximum impact energy when the ratio of shank area to thread-root area was equal to 1.17 for shanks reduced by drilling or 1.12 for shanks reduced by turning. Results for other sizes were similar.

It was concluded that for maximum energy absorption the shank area should approximately equal the mean or tensile-stress area of the threads, with minor corrections to compensate for work hardening due to thread rolling or surface oxidation resulting from heat-treatment.

Design Study of a Hydrostatic Gas Bearing With Inherent Orifice Compensation, by S. K. Grinnell, and H. H. Richardson, Massachusetts Institute of Technology, Cambridge, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-177 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

A HYDROSTATIC gas bearing can provide shaft support with very low friction in high-speed devices such as centrifuges and gyroscopes and in precision static devices such as dynamometers. For comparable load conditions, the friction torque required to rotate a hydrostatic bearing is from 100 to 10,000 times less than the friction torque required to rotate ball or hydrodynamic oil bearings.

This paper presents information directly applicable to designs with optimum performance characteristics for hydrostatic gas bearings with inherent orifice compensation. An analytical and experimental study of a simplified model of the basic unit of which the bearing is composed and a similar study of a complete journal bearing lead to a readily usable design procedure for the hydrostatic gas bearing. The load capacity, or stiffness, and weight flow rate predicted by the design procedure are verified within 10 and 20 per cent, respectively, by experimental results obtained with an optimized bearing.

The Diesel Engine's Progress and Future, by Mark Ogden, *Diesel Progress*, Los Angeles, Calif., and Bruce W. Wadman, *Diesel Progress*, Chicago, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-94 (multilithographed; available to Oct. 1, 1956).

TRIBUTE is paid the design engineers who have contributed to developing the diesel engine, and to those who have applied its specific capabilities toward improving the economy. The design-engineer's function in this development, and the limitations that hem him in, are discussed. The major improvements made in diesels since World War II and anticipated developments that lie ahead are outlined.

The Pursuit of Happiness, by Alfred V. Bodine, Bridgeport, Conn., 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-96 (multilithographed; available Oct. 1, 1956).

THIS paper points out that to most people—especially here in the United States—the pursuit of happiness means the earning of a fair living, moving up to a better job, or building up a business, acquiring the comforts and conveniences of life, etc. We certainly want good plumbing, good houses, good automobiles, and for that matter, television, in our pursuit of happiness.

We wrote into our Constitution provisions which guaranteed the individual in pursuit of happiness that he was free to go to work where he chose, quit his job and get a better one, go into business for himself, etc.

But, the paper states, as time went on, the development of monopolies stifled competition and thereby denied individuals their economic right to the "pursuit of happiness."

This situation was corrected by the Anti-Trust laws—a piece of legislation more conducive to the progress, prosperity, and standard of living of our country than any other law passed since the ratification of the Constitution by the original 13 states.

Today anybody can go into business; and if he has better products than his competitor, he can succeed in his pursuit of economic happiness.

Under the competitive free-enterprise system, a company that in the long run gives its customers the best buy for their money, gets business; a company that doesn't give its customers as good a value as its competitors, loses business.

Therefore, under the competitive system, every company tries to outdo his competitor in giving the best possible value to the customer; and that is what puts engineers into business in a big way.

This paper also discusses briefly the effect of ideologies, the fall of empires, individual freedom and inventions, the Cartel System, nationalized industries, the communistic approach, and ingredients of the cold war.

Dynamics of Instrument Bearing Torque Testing, by F. V. Johnson, Mem. ASME, General Electric Company, Schenectady, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-178** (multilithographed; available to Oct. 1, 1956).

THE establishing of standards for measuring and specifying instrument ball-bearing torques is known to require devices of mechanical precision. It is less generally recognized that it also requires the precise concepts and language of dynamic control and measurement.

While there are many types of torque-testing devices available, most are designed and used on a purely empirical basis, having outputs more or less related to bearing torque. As a basis of establishing standards of bearing excellence, such instruments should provide a true torque measurement as a function completely correlated with the performance of the instrument.

Mechanization on the Farm, by A. E. W. Johnson, International Harvester Company, Chicago, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-99** (multilithographed; available to Oct. 1, 1956).

BACK in 1880, when ASME was founded, the production of one farm worker was sufficient to support five and one-half persons. Today the production of one farm worker is sufficient to support about 18 persons.

Those figures, the paper states, give an idea of the magnitude of the change that has taken place in agriculture with the coming of mechanization.

In the farm-equipment industry of today you will find well-equipped engineering laboratories and engineering shops, extensive test and research facilities of various kinds, and professional-engineering personnel in all the relevant fields of specialization. Close associations with both the technical colleges and the agricultural colleges keep manufacturers in constant touch with new research and application developments.

Load Ratings for Miniature Ball Bearings, by T. S. Kauppinen, Mem. ASME, University of New Hampshire, Durham, N. H., and R. H. Carter, Mem. ASME, Miniature Precision Bearings, Inc., Keene, N. H. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-117** (multilithographed; available to Oct. 1, 1956).

NEW graphical data are presented for computing load ratings of miniature ball bearings of the radial, pivot, thrust, and self-aligning types. Standardized methods for evaluating load ratings, based on dimensional and geometric characteristics of larger ball bearings, are for the first time applied specifically to ball bearings in the miniature range below $^3/_8$ in. OD.

A brief review of the method for determining equivalent radial load for combined loads is given. The actual design load for a typical miniature radial ball bearing is calculated from basic dimensional data for combined radial and axial-load components.

Materials Handling

Pneumatic Conveying as Adapted to the Milling Industry, by F. G. Jun and E. J. Gehrig, Mem. ASME, The Quaker Oats Company, Chicago, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-166** (multilithographed; available to Oct. 1, 1956).

TEN years ago the only means of conveying materials in the conventional corn, wheat, oats, or barley mill was the "standard bucket elevator" and "screw conveyer." The average American mill contained from 50 to 60 elevators and from 400 to 800 ft of screw conveyer.

Today, this equipment is recognized as the breeding spot of infestation. The refinement of pneumatic conveying and its adoption to the milling industry has all but eliminated this possibility. Pneumatic mills are cleaner, require less building space, and can be operated more economically in comparison with the "conventional bucket-elevator mill."

More Movement—Less Investment—More Profit, by F. C. Wier, The Timken Roller Bearing Company, Canton, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-169** (multilithographed; available to Oct. 1, 1956).

THIS paper relates to the movement and storage of bars and tubes of alloy steel in a steel mill The principle demonstrated by the author is that more handling rather than less—sometimes moving products greater rather than shorter distances—and disregarding handling costs to some extent, can bring about an over-all cost reduction in total manufacturing cycle of a given product.

In summary the paper states that:

1 Storage be located in low-cost areas, not in high-priced buildings.

2 Such storage should be accomplished with minimum paper records, and employment should not be required in the storage areas.

3 Unit loads allow inexpensive movement which, in turn, permits dispersion of operations and outside storage of in-process materials.

4 Storage areas between buildings become desirable even though material movement increases.

5 Building costs are reduced by the elimination of the need for heavy construction to support overhead cranes.

6 Capital-investment accounts can be reduced drastically by the addition of well-executed flexible materials-handling methods.

Recognition of Materials Handling in Its Entirety for Proper Evaluation, by R. B. Gesse, Caterpillar Tractor Company, Peoria, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-167** (multilithographed; available to Oct. 1, 1956).

THE recognition of "materials handling" in its entirety has provided the foundation for established principles that have brought about a more efficient operation. Materials handling has become a more active function of management through reorganization of responsibilities.

Unit loading has eliminated much of the piece-by-piece handling and has increased greatly the effectiveness of mechanized equipment. Emphasis on employee training has done much to improve safety and to increase employee proficiency in handling material. The labor turnover has been reduced by eliminating hand labor on fatiguing jobs that can be done effectively and more cheaply by mechanized equipment.

Standardization has been an outstanding factor in promoting safety and increasing the proficiency of employees. No single approach to materials handling can be adapted to all types of businesses. However, possession of all the facts, coupled with adequate records and cost figures cannot be overlooked in evaluat-

ing an economical materials-handling operation.

Materials-Handling Analysis—Southern Plant—National Lead Company, by T. J. Eddy, National Lead Company, Chicago, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-168 (multilithographed; available to Oct. 1, 1956).

THIS study applies to the materials-handling problems of a Southern plant of the National Lead Company. It is confined to handling between the warehouse or shipping platform, the zinc-rod department, the mixed-metals department, and the wire-solder department.

Analysis of Air-Freight Operation, by J. K. Morris, Northwestern University, Chicago, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-171 (multilithographed; available to Oct. 1, 1956).

IN this paper, the author sets forth some generalized statements relative to potential installations that would enhance greatly the freight system and in the long run save the air lines substantial money—not to speak of improving their service and reducing their air-freight overhead.

1 Bring the aircraft into the terminal loading area by means of a gigantic belt conveyer. This project is in the experimental stage. In the Chicago operation there is a distance of 275 ft from the aircraft park position to the terminal dock. Danger and excessive time in travel are involved in transporting freight this distance.

2 Mechanically sort cargo from the receiving dock by electronic or magnetic impulse.

3 Following an automatic sorting routine, the freight would pass—by conveyer—through an underground tunnel directly to the aircraft-loading station.

4 When the aircraft has been secured at the loading station, an elevated conveyer can be raised from the tunnel exit through to the aircraft door.

5 Loading will take place simultaneously with the unloading process. The latter will involve the same methods but will operate through a door or hatch in the forward section.

Equipment has been built to handle this type of a freight operation. The installation would be highly feasible in areas suffering from inclement weather, as the handling takes place under cover. It would take a small crew to staff the handling—probably not more than five or six men—and the speed and efficiency would be improved greatly.

Fuels Technology

The Sintering Test—An Index to Ash-Fouling Tendency, by D. H. Barnhart and P. C. Williams, The Babcock & Wilcox Company, Research Center, Alliance, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-193 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THE sintering test is a valuable tool for evaluating the effect on fouling of the various factors in boiler operation that are available to the boiler operator. For a given coal, the two important factors would be the temperature of the ash deposit and the time it is permitted to remain on the tube. Operating conditions affecting temperature are the fuel-air balance in the burner region, over-all excess air, boiler rating, and surface cleanliness preceding the convection bank. The time the deposit is permitted to remain on the tube is governed by the frequency and effectiveness of soot blowing.

If a coal ash is found to be troublesome, the sintering test is useful in determining and evaluating the effect of additives in changing the ash characteristics. This can be done either in the laboratory or on full-scale field applications. A measure of the sintered strength would give an indication whether or not the additive would effectively turn the balance in favor of the force delivered by the soot blowers and thus enable the blowers to keep the boiler clean.

To facilitate extending this information a study is now under way for the purpose of developing a technique for the production in the laboratory of coal ash that will have the same characteristics as that obtained from field installations. If successful, this will supplant the need for ash samples obtained from firing coal in commercial units, as was done throughout this program.

Combustion Calculations for Multiple Fuels, by T. Buna, Riley Stoker Corporation, Worcester, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-185 (multilithographed; to be published in Trans. ASME; available to Oct., 1956).

A PROCEDURE is described for calculating steam-generator performance when a plurality of fuels is burned simultaneously. This procedure consists in determining the composite analysis of the multiple fuel and, using this analysis and available standard procedures, carrying out the calculations as for a single fuel. From the point of view of the calculations and their results, the essential difference between single and multiple fuels is the dependence of this composite analysis and heat content on an operating variable, namely, on the proportions of the firing rates of the component fuels. This variable affects the first and last stage of the mathematical side of boiler testing; the determination of the fuel analysis and heat content, which requires the determination of the proportions of the firing rates of the component fuels; and the estimating of uncertainties in the efficiency determinations, since the errors in the fuel weights will propagate through the computed fuel analysis into the final results.

A procedure for the calculation of the fuel analysis and heat content of the multiple fuel is described, and two equations for the calculation of the weight fractions of the component fuels when their weights are unknown are developed. If the number of unknown fuel weights is higher than two, the calculations are indeterminate. As a computational tool, the apparent heat losses and efficiencies of the component fuels have been defined. The apparent efficiencies—for given test data—are fuel characteristics rather than performance items, and indicate the relative positions of the component fuels in the multiple fuel. The apparent efficiencies also play a role in the computation of uncertainty intervals in the efficiencies.

The propagation of uncertainties in the test measurements in the efficiency calculations follow the same general pattern as for single fuels. Unless highly accurate flow-measuring devices are used, the efficiency determination by the indirect (heat-balance) method is recommended. This method is only slightly affected by errors in component fuel weights, and this effect depends on the ratio of the input of the component fuel to the total input of the multiple fuel, and on the apparent efficiency of the component fuel.

The graphical representation of the CO_2–O_2 excess-air relationship for multiple fuels is limited to two fuels fired simultaneously, and must include the weight fractions as parameters. A method has been developed for the graphical representation of this relationship in which all parameters depending on fuel analysis are straight line functions, while all other curves necessary for the interpretation or construction of the graphs are dimensionless relationships, hence reproducible, possibly, as part of a standard form.

Ash Deposits on Boiler Surfaces From Burning Central Illinois Coal, by J. R. Michel, Fellow ASME, Commonwealth Edison Company, Chicago, Ill., and L. S. Wilcoxson, Fellow ASME, The Babcock & Wilcox Company, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-95 (multilithogaphed; available to Oct. 1, 1956).

THE authors' companies, in studying the problem from several approaches, have learned much about the nature of ash deposition and ways of combating it. The alkalies in Central Illinois coal are the main cause for the bonded ash deposits which are found in stoker, pulverized-coal-fired, and cyclone-furnace boilers. They can be removed from the fuel by washing, but as yet an economical method for accomplishing this has not been found. It is also possible to neutralize the harmful effects of the alkalies by the use of additive materials. Work to date on additives has shown promise both in the laboratory and in the field; however, further work remains to be done on the application of this means to operating units. The need for closer control of boiler operating conditions is becoming more important as steam temperatures increase and continuous operation at high ratings is required. Investigations, which have led to improved cleaning ability of soot blowers, the use of gas tempering, and careful attention to operating conditions have resulted in marked increases in availability of units burning Central Illinois coal. It is now possible at Fisk Station to attain, as a regular practice, one-year operating periods with no hand-lancing of heat-absorbing surfaces when burning Central Illinois coal. Similar performance is expected on the higher-duty boilers at Ridgeland and Will County Stations.

However, the problem of ash fouling is a continuing one. The demand for larger higher-duty boilers and the resultant increase in gas temperatures will undoubtedly bring about new problems in this field. The authors' companies are, therefore, continuing their research investigations.

Production Engineering

Research Problems in Production Routing and Scheduling, by A. J. Rowe, Assoc. Mem. ASME, and J. R. Jackson, University of California, Los Angeles, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-148 (multilithographed; available to Oct. 1, 1956).

THE interdependence of the production problems of choosing routings, determining lot sizes, and deciding upon methods for detail scheduling is discussed. It is suggested that these problems be studied by the use of electronic computers to perform simulated experiments. The application of this technique to these problems is described in general terms, and an illustrative example is given. Specific types of problems are examined with reference to the use of simulated experimentation. Applications of this method in basic research concerned with scheduling methods are described, and the results obtained so far are outlined.

Oil and Gas Power

A Rational Approach to Crankshaft Design, by C. M. Lowell, Mem. ASME, Worthington Corporation, Buffalo, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-57 (multilithographed; available to Oct. 1, 1956).

IN the past, and even at the present time, crankshaft design for the most part consists of an empirical approach using "nominal" stress values at various locations in the crank throw as criteria.

This paper presents a design method centered around stress concentration which, particularly for crankshafts of modern design, with large overlapping of crankpin and main journal, more nearly approaches the actual stress conditions present.

Rubber and Plastics

The Engineer in the World of Commerce and Industry, by D. L. Gibb, Dow Chemical Company, Midland, Mich. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-207 (multilithographed; available to Oct. 1, 1956).

FOR a summary of this paper, see page 336 in the April, 1956, issue of MECHANICAL ENGINEERING.

Power Test Codes

A Practical Application of Uncertainty Calculations to Measured Data, by L. W. Thrasher, Assoc. Mem. ASME, California Research Corp., La Habra, Calif., and R. C. Binder, Mem. ASME, Purdue University, West Lafayette, Ind. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-205 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

IN order to answer questions as to the reliability of measurements, it is desirable to classify two types of measurements: The multiple sample and the single sample. The case for multiple-sample measurement is well established, whereas the case for single sample has not been established. It is proposed that the tester estimate his error—the uncertainty interval—and give odds that the error would be less than the uncertainty interval if the measurement were repeated a large number of times. A numerical example is presented.

Instrumentation for Steam-Consumption Tests on Medium Steam Turbine-Generator Tests, by D. E. Kimball, Mem. ASME, General Electric Company, West Lynn, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-206 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

A PREVIOUS paper discussed various measures of the uncertainties of the data of precision steam-consumption tests on medium-sized steam turbine-generator sets, deriving them from the over-all results of the tests and from comparisons of duplicate instruments used in them. In the present paper, the instruments and their calibrations are briefly described and typical calibration corrections are presented. The instruments and their calibrations have been used for many years.

Most comparisons presented here demonstrate that instruments of high precision have small calibration corrections which are significant and that most corrections do not change significantly. They also show that these instruments can be relied upon in very precise turbine steam-consumption tests.

Availability List for 1956 ASME Instruments and Regulators Division Conference Papers

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Paper No.	*Title and Author*
56—IRD-1	Nonlinear Analogue Study of a High-Pressure Pneumatic Servomechanism, by J. L. Shearer
56—IRD-2	On the Analysis of Linear and Nonlinear Systems, by Marvin Shinbrot
56—IRD-3	Nonlinear Integral Compensation of a Velocity-Lag Servomechanism With Backlash, by C. N. Shen, H. A. Miller, and N. B. Nichols
56—IRD-4	A Résumé of the Development and Literature of Nonlinear Control-System Theory, by T. J. Higgins

56—IRD-5 How to Obtain Describing Functions for Nonlinear Feedback Systems, by Karl Klotter

56—IRD-6 A Dual-Mode Damper-Stabilized Servo, by J. Jursik, J. F. Kaiser, and J. E. Ward

56—IRD-7 Nonlinear Phenomena, by C. A. Ludeke

56—IRD-8 Electrohydraulic Servomechanism With an Ultrahigh Frequency Response, by D. P. Eckman, C. K. Taft, and R. H. Schuman

56—IRD-9 Basic Methods for Nonlinear Control System Analysis, by T. M. Stout

56—IRD-10 Design and Analog-Computer Analysis of an Optimum Third-Order Nonlinear Servomechanism, by H. G. Doll and T. M. Stout

56—IRD-11 Representation of Nonlinear Functions of Two Input Variables on Analog Equipment, by D. A. Elliott

56—IRD-12 Hunting Due to Lost Motion, by H. Poritsky

56—IRD-13 Optimum Nonlinear Control, by R. Oldenburger

56—IRD-14 Experiments With Optimalizing Controls Applied to Rapid Control-of Engine Pressures With High-Amplitude Noise Signals, by G. Vasu

56—IRD-15 Spectral Response of Control System Containing Zero-Memory Nonlinearity to Random Inputs, by Y. Sawaragi and S. Takahashi

56—IRD-16 Physical and Mathematical Mechanisms of Instability in Nonlinear Automatic Control Systems, by R. E. Kalman

56—IRD-17 Determination of the Characteristics of Multi-Input and Nonlinear Systems From Normal Operating Records, by T. P. Goodman

56—IRD-18 Effects of Nonlinearities in Multiloop-Angle Prediction Systems, by A. A. Clark and H. J. Pixley

ASME Transactions

for April, 1956

THE April, 1956, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following technical papers:

Journal-Bearing Performance for Combinations of Steady, Fundamental, and Low-Amplitude Harmonic Components of Load, by G. S. A. Shawki. (55—LUB-15)

Analytical Study of Journal-Bearing Performance Under Variable Loads, by G. S. A. Shawki. (55—LUB-16)

Studies in Lubrication—XI, by A. S. C. Ying, A. Charnes, and E. Saibel. (55—LUB-13)

Journal-Bearing Operation at Superlaminar Speeds, by M. I. Smith and D. D. Fuller. (55—LUB-26)

The Dall Flow Tube, by I. O. Miner. (54—A-139)

Two and Three-Dimensional Flow of Air Through Square-Edged Sonic Orifices, by Alexander Weir, Jr., J. L. York, and R. B. Morrison. (54—A-112)

On the Theory of Discharge Coefficients for Rounded-Entrance Flowmeters and Venturis, by M. A. Rivas, Jr., and A. H. Shapiro. (54—A-98)

Biaxial Plastic Stress-Strain Relations of a Mild Steel for Variable Stress Ratios, by Joseph Marin and L. W. Hu. (54—A-243)

A Method of Predicting the Effects of Notches in Uniaxial Fatigue, by W. E. Dirkes. (54—A-180)

The Stress-Rupture Strength of Type 347 Stainless Steel Under Cyclic Temperature, by E. E. Baldwin. (54—A-231)

Design Aspects of High-Temperature Fatigue With Particular Reference to Thermal Stresses, by L. F. Coffin, Jr. (54—A-252)

Quantitative Evaluation of Thermal-Shock Resistance, by S. S. Manson and R. W. Smith. (54—A-263)

Approximate Solution to Thermal-Shock Problems in Plates, Hollow Spheres, and Cylinders With Heat Transfer at Two Surfaces, by A. Mendelson and S. S. Manson. (54—A-264)

A Survey of Aerodynamic Excitation Problems in Turbomachines, by A. Sabatiuk and F. Sisto. (55—SA-40)

A Practical Approach to the Problem of Stall Flutter, by Chi-Teh Wang, R. J. Vaccaro, and D. F. De Santo. (55—SA-69)

The Flow in a Vee-Gutter Cascade, by W. G. Cornell. (55—SA-58)

Determination of Mach Number From Pressure Measurements, by F. W. Barry. (55—SA-28)

Some Aerodynamic Investigations in Centrifugal Impellers, by J. T. Hamrick. (55—SA-53)

A Three-Dimensional Spherical Pitot Probe, by J. C. Lee and J. E. Ash. (55—SA-56)

The Combustion of Liquid-Fuel Spray, by J. A. Bolt and T. A. Boyle. (55—SA-67)

The Aerothermopressor—A Device for Improving the Performance of a Gas-Turbine Power Plant, by A. H. Shapiro, K. R. Wadleigh, B. D. Gavril, and A. A. Fowle. (55—SA-65)

A New Electrical Analog Method for the Solution of Transient Head-Conduction Problems, by G. Liebmann. (55—SA-15)

Thermal Properties of Titanium Alloys and Selected Tool Materials, by E. G. Loewen. (55—SA-45)

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Note: No digests are made of ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING.

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Offshore Drilling

Comment by Carl J. Lamb[1]

WHILE our experience covers only one phase of this excellent and constructive paper,[2] we can amplify the rather brief mention of "Offshore Problems." Fortunately, the incentive to drill offshore in the Gulf brought forth several different designs of mobile self-elevating or submersible drilling vessels. Such vessels have been built to the designs of civil engineers, mechanical engineers, petroleum engineers, shipbuilders, and naval architects. The majority of offshore drilling has been done from fixed stationary platforms, mounted on piles, with the platform either large and self-contained, or small and served by a drilling tender, as illustrated in the paper.

In the development of offshore floating drilling equipment, our firm found it necessary to incorporate soil engineering, civil engineering oceanography, and an acquaintanceship with petroleum engineering into vessel designs produced by naval architects for a particular service. We have, of course, learned much from the experience of others, including De-Long. We have found that, to meet drilling requirements in various depths of water most economically, different basic designs are necessary. Where the nature of the bottom permits we use a floating platform elevated above the surface of the water on hydraulically operated spuds.

Owing to the nature of the gulf bottom, the seven units which have been built or are being built to our design for operating in depths of water down to 75 ft, consist principally of submersible hulls (essentially nonscouring ballasted-steel spread-footings) having the drilling-platform decks elevated varying distances above the hull on fixed cylindrical columns, depending upon the depth of water in which the vessel is designed to work.

For servicing either fixed or mobile drilling platforms, the designs for special supply vessels, crew boats, mooring buoys, floating helicopter landing platforms have been developed, and drilling tenders for small fixed platforms, both propelled and nonpropelled, have been designed.

It is anticipated that drilling from mobile platforms in waters 150 ft deep will be required in the near future. For such service vessels have been designed consisting of a drilling hull nested on a submersible hull of spread-footing design. When the drilling site is reached, the lower hull is submerged to the bottom hydraulically, and the upper hull is then raised hydraulically the required distance above the water.

The foregoing types of equipment are for particular geographic locations. In other parts of the world, for example off the Pacific Coast, bottom, water depths, and so on, probably will dictate quite different designs. It is safe to predict, however, that successful and economic units for offshore drilling in any location will be designed by experienced naval architects and marine engineers.

[1] Chief Engineer, Friede & Goldman, Inc., New Orleans, La. Mem. ASME.

[2] "Mechanical Engineering in the Petroleum Industry," by E. W. Jacobson, Mechanical Engineering, vol. 77, December, 1955, pp. 1047–1052.

Comment by L. N. Scharnberg[3]

The author has given a comprehensive and intriguing "peep into the future" of the mechanical engineer in the petroleum industry.

As he so ably states, that engineer will continue to find himself deeply involved in the fight against corrosion. The formation of complex and unknown compounds, however small in quantity, in a modern refinery process eventually will show up in vessels or piping in places that "just can't" have holes. As in the past, he will continue to crowd the borderline of known knowledge of construction materials to build the new refining processes and force the development of new metals or other materials to solve his problems already on the drafting boards.

During the "roaring twenties" he forced the development of alloy metals to solve the demands of high temperature and high pressure then used in the cracking processes of oil refineries. Those metals made possible the superpower reheat cycles of the period between 1930 and 1950, and unquestionably made possible the development of rockets, gas turbines, jets, and implements of war that helped our side to win.

Possibly the new knowledge released recently by the Task Group on Brittle Failure of Large Steel Forgings will help the petroleum mechanical engineer solve his newest "headache"; namely, the proper design—selection of prime movers ranging in size from 5000 to 18,000 hp and speeds of 6000 to 15,000 rpm to drive properly and continuously the centrifugal blowers he is now requiring in larger and larger petrochemical processes.

[3] Supervisor of Utilities Engineering Division, Manufacturing Department, Gulf Oil Corporation, Pittsburgh, Pa. Mem. ASME.

Comment by A. H. Newberg[4]

The author has excellently described the broad field of real problems challenging the mechanical engineer in the petroleum industry. He also should be congratulated on enumerating specific examples of progress being made as well as the problems yet to be solved.

The petroleum industry is a vigorous leader in research and promotion of use of new developments. The present total industrial-research bill amounts to an estimated $4 billion for 1955 compared with $400 million 25 years ago. Industrial research is predicted to be $16 billion annually 20 years from now. This represents an expansion in research of 10 per cent to 12 per cent annually compared with a 3 per cent annual growth of the gross national product. The petroleum industry in 25 years has at least kept pace in research expenditures and has tripled its over-all investment in the last 10 years. It now occupies third place in this respect. The mechanical engineer has played an important part in this growth.

All of this points up the need for broader training of the mechanical engineer since, as the author so ably points out, every phase of the petroleum industry needs men with technological mechanical training of the highest order. As stated

[4] Chief Engineer, Service Pipe Line Company, Tulsa, Okla.

in the paper, "there has been an avalanche of changes in the field of instrumentation itself." So many new devices and control systems are being offered to the industry today, many right from the development stage, that the petroleum mechanical engineer is sore put to make proper application of such facilities to any particular operation. It is not enough that he understand basic pneumatic or hydraulic instrumentation. He must involve himself with understanding electrical and electronic sensing elements, pressure pickups, and control units. In pipe-line pump-station design today, it is impossible to separate the mechanical and electrical design. While specialists are certainly needed, they need to widen their scope of work if a true contribution to technological progress in the industry is to be made. Unlike instruments and controls of yesterday which were secondary to a process or pipe-line operation and could therefore be disconnected when trouble occurred, today's instruments and controls are an integral part of the operation and must perform efficiently and reliably to justify their use.

This high order of mechanical technology is also needed in the more recent growing child of the industry–petrochemicals, since many of the mechanical problems involved in processing natural gas and crude into chemicals require unique mechanical designs for high pressures and temperatures not ordinarily encountered in other industries. Special materials for these processes and unique uses of ordinary materials follow from these requirements.

The statement under Pipe-Line Transportation of Oil, "Measurement with positive-displacement meters has removed the cost and inaccuracy of tank gaging for pipe-line oil and cut down on the number of storage tanks required," needs some clarification.

The positive-displacement-meter method for custody transfer has not been generally accepted in the industry as yet for crude-oil measurement. This is primarily due to the nonuniform physical properties of a crude stream and the excessive inspection and maintenance of the meters required to sustain accuracy. We will agree with the author in his statement that positive-displacement meters will take their place as another important mechanical-engineering device when these difficulties and the wax-and-hydrate problems are overcome. The forthcoming revision and expansion of the P-D Meter Code will represent an interim step in industry—increased acceptance of P-D meters for custody transfer of crude oil.

The writer believes that today's opportunities and challenges are great. Tomorrow's will be even greater for the mechanical engineer who is prepared and seeks for better understanding of how new materials and equipment and applied research can economically better the petroleum industry's position and likewise our national economy.

Author's Closure

The generally favorable acceptance of and comments on the subject paper are very gratifying to the author. A primary intent of the paper is to awake the mechanical engineer both within and without the petroleum industry to the very large place mechanical engineering has in that industry. The great interdependence of mechanical engineering in one industry on that in other industries often is too little realized. The sum total of all research and development in all industries adds to the general level of advancement in an individual industry such as petroleum. The perceiving, sorting out, and application of the individual improvements is the personal job of each mechanical engineer. Opportunities in the petroleum industry for young mechanical engineers with their fresh thinking and strong initiative are greater today than ever before.

E. W. Jacobson.[5]

Mechanical Engineering in the Petroleun Industry

Comment by J. R. Mahan[6]

THIS brief historical review[7] really offers little opportunity for discussion. Obviously, the author has been handicapped by the necessity of compressing so much information into a paper of reasonable length, and the writer's only comments are by way of amplification of some of his statements.

Under the subject of current drilling developments, it is thought the author should have explained that the sonic and magnetostriction devices are simply forms of transducers for the rotary-percussion method of drilling. Investigations have shown that the rate of penetration is somewhat proportional to the power expended against the rock face, and the rotary-percussion method increases the power at the bit by superimposing a vibratory or percussive loading upon the conventional rock bit.

Perhaps an interesting sidelight on the statement regarding the drilling of the world's deepest well is that the machinery involved was actually not the heaviest available and, in fact, was a rig built in 1946 and normally used in the 12,000 to 15,000-ft depth range.

The author mentions 10,000-psi working-pressure wellhead equipment. Very recently, some extraordinarily high pressures of around 12,000 psi have been encountered. The wellhead industry is conducting a co-operative project for the design of bolted joints for 15,000-psi working pressure. Obviously, this is a real design problem considering the diameter of the joints involved.

Comment by W. L. Ducker[8]

The task that confronted the author, in contemplating this paper, must have been not unlike that which would confront a pocket-digest rewriter faced with Toynbee's "Study of History." It is also probable that the required—and almost impossible—degree of condensation would inevitably force an editorial style strongly reminiscent of the hardware section of a mail-order catalog.

A second inevitable consequence of such a degree of condensation is that much material of significance must, of necessity, be omitted. Yet care should be taken that the material omitted be of the same kind as the material included, lest such omission alter the true completion of the subject.

Progress is a phase of the history of the industry, and in common with other histories, is the result of battles won and of battles lost, and although usually the result of battles won, a review of progress should probably mention as well the battles lost, if it is to avoid that cheerful, bright, and false aura which so typically colors recollections of earlier, but not necessarily easier, days.

The author has done a good job of delineating the progress of mechanical engineering in the petroleum industry, and possibly that was the end sought. On the other hand, that that progress is the result of many hard-fought battles is a fact well known to the author and to the many engineers, who like himself,

[5] Chief Design Engineer, Gulf Research & Development Company, Pittsburgh, Pa. Mem. ASME.

[6] Director of Engineering, The National Supply Co., Pittsburgh, Pa. Mem. ASME.

[7] "Mechanical Engineering Progress in the Petroleum Industry," by E. N. Kemler, MECHANICAL ENGINEERING, vol. 77, December, 1955, pp. 1042–1046. Dr. Kemler died early in December, 1955.

[8] Professor and Head of Department of Petroleum Engineering, Texas Technological College, Lubbock, Tex. Mem. ASME.

helped make that progress, but a fact which may not be made sufficiently clear to the uninitiated reader.

Automation in Metalworking

Comment by P. H. Alspach[9]

THIS PAPER[10] brings out excellently the many sides to the development of automation in metalworking. It also points out that this development has been evolutionary and not revolutionary and that it is merely the next step of our industrial development.

This point might be clarified further by referring to the "progressive steps to automation" chart, Fig. 1, herewith, which shows how the skills of the manual worker are being upgraded progressively along with process equipment and material-handling equipment.

It also shows that automation is the integration of the automatic machine with suitable controls and transfer equipment.

This paper is thought to present very well the industrial interpretation of automation today and point out that it is becoming a way of manufacturing based on the continuous-flow concept rather than the batch concept.

The comments on automatic assembly are very timely as there is much activity being directed toward this end by the metalworking industries.

It should be mentioned that the eventual extent of automation is dependent to a large degree, upon how well our design engineers meet the challenge of designing for automatic manufacturing. That means they will have to design out the manual operation and design in operations that can be performed automatically by equipment.

The word "automation" is good. It is a way of manufacturing whether it is modestly applied to the manufacture of component parts, or boldly applied to the manufacture of entire products. It is the next progressive step to meet the problem of achieving our industrial goals.

Comment by J. F. Reintjes[11]

It was a pleasure to read this detailed history of the use of automatic equipment in the metalworking field. As the author points out, automatic machines for metal cutting and materials handling, far from being new, have been evolving gradually over a period of many years.

Several factors are contributing to the present intense interest in automation. These may be listed under the following headings:

1 The introduction of continuous automatic-production equipment into a wide variety of industries, outside the metalworking field.

2 The employment of large-scale, general-purpose, and special-purpose digital data-processing machines in business and industry.

3 The use of feedback techniques for automatic control of processes and machines, and

4 The combining of digital computers with servomechanisms for the purpose of achieving programmed automatic control.

Coupled with these factors is still another one which may be called the "second-derivative" effect; namely, one can observe at present an increase in the rate at which automatic equipment is appearing in many branches of business and industry.

All of these factors together are creating an intense interest in automation because of their implications and possible influence on our way of living. The penetration of computers, feedback-control devices, and combinations of these, as well as the more widespread use of conventional automatic-production and transfer equipments inevitably will mean that the character of jobs will change. The ability of the laboring man to adjust to this change will depend upon his flexibility of mind as well as his ability to take another kind of job—in many instances, perhaps, an upgraded job.

Many engineers and scientists also face change, particularly those of us who received our formal education and served our engineering internship in another era—for mid-twentieth-century technology includes many concepts and techniques which have become generally available only within the past few years. Recent graduates will move naturally into the slipstream of progress because they are familiar with these concepts. Older graduates will have to acquire these new professional skills to keep apace.

Another implication of automation is that in many industries productivity per man-hour very likely will increase. This, again, is an old effect where automated processes have been in vogue for many years, but the second-derivative effect just mentioned focuses attention, not only upon how we are to make good use of leisure but also on how we are to finance it. If the work week is to be reduced, it must be done without creating a sense of

[9] Manager—Equipment Development, General Electric Company, Schenectady, N. Y.

[10] "Automation—Its Development in Metalworking," by Anderson Ashburn, MECHANICAL ENGINEERING, vol. 77, November, 1955, pp. 958–963.

[11] Associate Professor of Electrical Communications, Massachusetts Institute of Technology, Cambridge, Mass.

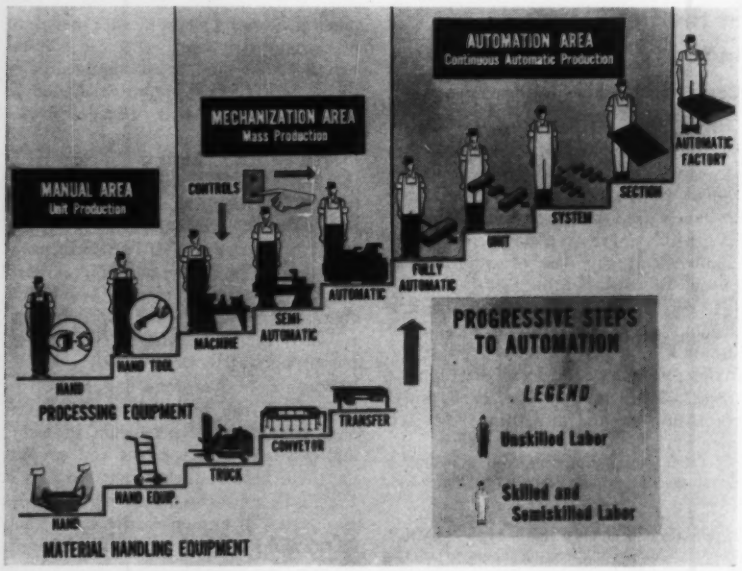


Fig. 1 Progressive steps to automation lead from the area of unit production to continuous automatic production, paralleled by developments in material-handling equipment

idleness or unemployment. The problem of whether increased productivity shall result in increased wages or reduced working hours at the same wage is not a trivial one.

In summary, the writer would say we should all want automation to grow and expand, but we should not turn our backs on its implications. Rather, we should plan intelligently for it. Intelligent planning implies planning by management in areas which are primarily management's concern and planning by labor in areas which are primarily labor's concern. But most of all it applies co-ordinated planning by both management and labor in the many areas which are of mutual concern.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Reactor Shielding Design

REACTOR SHIELDING DESIGN MANUAL. Edited by Theodore Rockwell, 3rd. With Foreword by Admiral H. G. Rickover. Naval Reactors Branch, Division of Reactor Development, U. S. Atomic Energy Commission, 1956. Paper, 7¼ × 10 in., figs., tables, references, plates, xii and 465 pp., $2.10. Available from the office of Technical Services, Department of Commerce, Washington 25, D. C.

Reviewed by M. L. Ireland, Jr.[1]

THE manual under review, Shielding Design, is one of a series of technical manuals sponsored by the Naval Reactors Branch of the AEC. Previously issued manuals cover liquid metals, zirconium, beryllium, and a bibliography of reactor computer codes. Additional manuals are in preparation for corrosion and wear in water-cooled reactors, naval reactor physics design, reactor core design, reactor plant piping, reactor heat transfer, and the metal hafnium.

This entire series of manuals are an effective answer to the complaints that declassification procedures are too slow and that release of previously classified documents on a bulk basis provides the specific information seeker with a "needle in a haystack."

The Shielding Manual contains ten chapters which cover the entire range of design procedures including the essential theoretical background, and also valuable information on shielding materials and methods of construction. Ten authors are listed but as the editor indicates in his preface individual authorship was sacrificed to coherence and the result is obviously well worth the required additional effort.

The first chapter presents basic principles including a justification for the neutron-removal cross-section concept and a brief discussion of build-up factors for the gamma-absorption equations. Specific design procedures are detailed in chapter 3, "shielding the reactor core" and in chapter 4, "shielding the reactor cooling system."

Permissible radiation levels, biological equivalents, and specific applications of tolerances, including considerations of access time, power level, and local streaming are given in chapter 2.

Plant-layout factors including distance effect, optimization of primary and secondary shielding, and shadow-shielding concepts appear in chapter 5.

Chapter 6 provides detailed information on physical and shielding properties of usable materials, fabrication and assembly details, and operational test procedures for measuring radiation levels.

A separate chapter 7 is required for the special problems related to safe access after shutdown. This chapter includes valuable and previously unpublished information on activation of impurities in the coolant system and studies of possible fission-product contamination.

Chapter 8 treats the numerous problems of shield penetrations and other irregularities such as defects in a specific and practical manner. The gamma-scattering problem at shield boundaries is also thoroughly covered.

The final chapters, 9 and 10, provide a summary of the reference mathematics (including derivations) for radiation flux geometry and basic data and curves for build-up factors, absorption coefficients, cross sections, and radiation-damage summaries.

It is hoped that this brief summary conveys some idea of the immense amount of shielding information collected from many sources which are still classified and presented for the first time in a single volume, which is now available to the public.

The fact that an entire series of such manuals covering naval reactor technology are being issued is attributable to the foresight of Rear Admiral H. G. Rickover who has permitted the work to be done by qualified engineers, physicists, and mathematicians even at the expense of urgent daily commitments.

[1] Atomic Power Engineering, Newport News Shipbuilding and Dry Dock Company, Newport News, Va. Mem. ASME.

Books Received in Library

AIR CONDITIONING AND REFRIGERATING DATA BOOK. Design Volume. Ninth edition, 1955, The American Society of Refrigerating Engineers, New York, N. Y. Various pagings, 6½ × 9⅜ in., bound. $10. Fundamental data and basic engineering information are presented in six sections devoted to theory, physical data, application design, equipment, auxiliaries and self-contained units, and operation. A seventh section includes tables and charts of refrigerants, weather and water data, and other information. In this edition, the chapter on air distribution has been rewritten, fuller coverage is given to expansion valves and other control devices, and substantial revisions have been made throughout to bring the text up to date.

AIRCRAFT GAS TURBINES. By C. W. Smith. 1956, John Wiley & Sons, Inc., New York, N. Y. 448 p., 6 × 9¼ in., bound. $8.75. The aim of this book is to provide for engineers a well-rounded picture of the aircraft gas-turbine power plant, with somewhat greater emphasis on the theoretical aspects than on mechanical and structural details. The Brayton and other gas-turbine cycles, theory of flow in ducts, nozzles, and diffusers, and the design of components are fully treated. Selected problems of stresses, materials, performance, and installation are also discussed. The book contains sufficient aerodynamic and thermodynamic theory for full understanding of the contents without recourse to other texts.

DIE DESIGNING AND ESTIMATING. Edited by W. N. Nordquist. Fourth edition, 1955, Huebner Publications, Inc., Cleveland, Ohio. Various pagings, 6¼ × 9¼ in., bound. $7.50. A detailed discussion of design principles for the basic dies, supplemented by descriptions of the use of dies in production and brief treatment of the more common specialized types. Among the dies covered are blanking, piercing, cutting, compound, drawing, deep-draw, and progressive dies. A special section gives procedures for predetermining die costs, and a list of practical

points in die design and construction is appended.

ELECTRIC GENERATION: STEAM STATIONS. Edited by B. G. A. Skrotzki. 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 454 p., $6^1/_4 \times 9^1/_4$ in., bound. $8.50. A treatment in simple terms of the basic principles of design, operation, and maintenance. Practical information of fuels, fuel and ash handling, steam generators, and fuel-burning equipment is included; piping systems, turbines, condensers, and water treatment are covered in detail. Also discussed are instruments and control, electric generators, station circuits, auxiliary drives, and superpressure stations. The mathematics used is limited to arithmetic and simple algebra.

THE FORESEEABLE FUTURE. By Sir George Thomson. 1955, Cambridge University Press, New York, N. Y., 166 p., $5 \times 7^1/_2$ in., bound. $2.50. A forecast, by an eminent British scientist, of the technical advances that are likely to be made in the fields of power, materials, transport communications, weather, food, and biology by the further development of presently known scientific principles. The social consequences of the changes foreseen are also discussed, and one chapter, on artificial and natural thought, deals with such subjects as future applications of computers and possibilities for improving the human brain.

FLUID FLOW IN PRACTICE. Edited by J. R. Caddell. 1956, Reinhold Publishing Corporation, New York, N. Y. 119 p., $5^1/_4 \times 7^5/_8$ in., bound. $3. A concise treatment of selected aspects of the flow of fluids (including slurries) in pipe lines and pumps, with some attention given to applications for gases. The volume is made up of six papers covering the following subjects: Basic principles; planning piping systems; the selection of valves, pumps, and flowmeters; operation and maintenance of equipment; and trends in research. This is the third volume in an "Experience in Industry" symposium series.

FLUIDIZATION. Edited by Donald F. Othmer. 1956, Reinhold Publishing Corporation, New York, N. Y. 231 p., $6^1/_8 \times 9^1/_4$ in., bound. $7. This book is based in part on a symposium on the subject held at the Polytechnic Institute of Brooklyn in 1955. Two chapters on the interrelations of hydromechanics, heat transfer, and mass transfer have been added to the original papers which deal with general aspects of the history, background, and possible future applications of fluidization, and with engineering aspects of the design and operation of plants. In the latter category are papers on fluid coking, moving solids bed systems, and fluid catalytic-cracking units.

FUEL: SOLID, LIQUID, AND GASEOUS. By J. S. S. Brame and J. G. King. Fifth edition, 1955, Edward Arnold (Publishers) Ltd., London, England. 551 p., $6 \times 9^1/_4$ in., bound. Available from St. Martin's Press, Inc., New York, N. Y. $10. A broad introduction to the properties and uses of the more common fuels. The book deals with the constituents, composition, classification, and varieties of coal; coal preparation and storage; carbonization and cokes; the production and character of oil fuels; producer gas; water gas; and such fuels as peat, benzol, alcohol, and diesel oil. Also included are chapters on combustion, flame, and other essential properties, fuel analysis, and combustion for heat and power.

HANDBOOK OF FASTENING AND JOINING OF METAL PARTS. By V. H. Laughner and A. D. Hargan. 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 622 p., $8^3/_4 \times 11^1/_4$ in., bound. $15. The aim of this large volume has been to provide the design engineer with a reference and an idea source covering all known methods of joining metal parts. The first section covers fundamentals of the various fasteners and fastening techniques: Screws, bolts, and nuts; locking nuts; design of screw fastenings; riveting; welding; brazing and soldering; adhesive; bonded joints; couplings; clamps; snap slides; and others. Varying with the subject under discussion, the information given includes descriptions and tables of standard sizes, advantages and disadvantages, and types of materials and products for which each technique is best suited. The second section consists of 200 pages of sketches with brief notes, illustrating 1500 ideas for handling fastening problems.

HYDRAULIC INSTITUTE STANDARDS. Tenth edition, 1955, Hydraulic Institute, New York, N. Y. Various pagings, $9^3/_4 \times 11^1/_2$ in., loose-leaf binder. $4.75. These standards provide up-to-date information on the classification, nomenclature, applications, rating, testing, installation, operation, and maintenance of reciprocating, rotary, and centrifugal pumps, along with data on friction loss for water and viscous liquids, pipe dimensions, properties of water, viscosity of common liquids, and materials of construction for pumping various liquids. The volume also includes examples of solved problems relating to such subjects as calculation of net positive suction head and calculation of pump sizes for specific conditions of head and volume.

HYDRAULISCHE PRESSEN UND DRUCKFLÜSSIGKEITSANLAGEN. Volume 2. By Ernst Müller. 1955, Springer-Verlag, Berlin, Germany. 278 p., $6^1/_4 \times 9^1/_4$ in., bound. 39 DM. This second volume of a two-volume set on hydraulic presses and equipment deals with presses for the production and fabrication of steel pipe, hollow shapes, boiler plates, ship plates, and other sheet-steel parts. Sections 1 to 5 cover the design, construction, and operation of hydraulic presses for the above work, while section 6 covers the control and driving equipment for all presses dealt with in the two volumes.

INTRODUCTION TO MODERN PHYSICS. By F. K. Richtmyer, E. H. Kennard, and T. Lauritsen. Fifth edition, 1955, McGraw-Hill Book Company, Inc., New York, N. Y. 666 p., $6 \times 9^1/_4$ in., bound. $8.50. Although extensive changes have been made in the preparation of the new edition of this standard text, an effort has been made to retain its characteristic features, especially the historical treatment of new fields and thorough discussion of selected subjects in preference to a general summary of the entire subject. The principal changes include expanded treatment of wave mechanics and spectroscopy, and rewriting of the chapters on nuclear physics and cosmic rays.

INTRODUCTION TO NUMERICAL ANALYSIS. By F. B. Hildebrand. 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 511 p., $6^1/_4 \times 9^1/_4$ in., bound. $8.50. Covers the basic operations of computation, approximation, interpolation, differentiation, integration, and the numerical solution of equations, as well as applications to such processes as smoothing of data, summation of series, and numerical solution of ordinary differential equations. Consideration is given to error analysis, convergence, and stability. Throughout the book formulas are derived in a manner that illustrates underlying hypotheses and methods of generalization and modification. A bibliography of 276 references is included.

INDUSTRIAL MANAGEMENT. By R. H. Lansburgh and W. R. Spriegel. Fifth edition, revised by W. R. Spriegel, 1955, John Wiley & Sons, Inc., New York, N. Y. Various pagings, $6 \times 9^1/_4$ in., bound. $6.75. Policies and principles of successful management are presented, with the devices necessary for carrying them out, keeping in mind the needs both of the student and the executive. Throughout the book an effort has been made to show the interdependence of the various major departments of a business. This fifth edition has been revised to cover recent developments in the field, including a new chapter on job evaluation and expanded discussion on inspection processes and quality control. There is a broadly classified bibliography.

KNICKEN. By C. F. Kollbrunner and M. Meister. 1955, Springer-Verlag, Berlin, Germany, 232 p., $6^1/_4 \times 9^1/_4$ in., bound. 27 DM. A comprehensive treatment of buckling which summarizes the various theories to date and describes in detail the different methods of analysis of buckling members of various types including columns and curved members, ring and arch sections. Existing German, French, Swiss, Austrian, and British specifications with regard to buckling are presented and discussed in the final chapter.

DIE KREISELPUMPEN FÜR FLÜSSIGKEITEN UND GASE. By Carl Pfleiderer. Fourth edition, 1955, Springer-Verlag, Berlin, Germany. 589 p., $6^1/_4 \times 9^1/_4$ in., bound. 58.50 DM. This well-known work on centrifugal pumps has again been considerably revised and enlarged to include the latest results of hydrodynamic research and practice. It covers both liquids and gases, and in addition to pumps, deals with ventilators, blowers, and compressors. A comprehensive review of both theory and design, the book is well suited to the needs of practicing engineers.

MATERIALS HANDBOOK. By George S. Brady. Eighth edition, 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 1022 p., $6^1/_4 \times 9^1/_4$ in., bound. $11. This standard reference volume gives information on the general characteristics, sources, and uses of metals, refractories, fibers, woods, plastics, and other classes of raw and processed materials used in industry. In many cases data on patented or trade-marked products are provided in order to give a more specific understanding of commercial applications. This edition, enlarged by about one hundred pages, covers approximately 10,000 materials.

MATHEMATICAL THEORY OF ELASTICITY. By I. S. Sokolnikoff. Second edition, 1956, McGraw-Hill Book Company, Inc., New

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

York, N. Y. 476 p., 6¼ × 9¼ in., bound. $9.50. The first three chapters—on the analysis of strain, the analysis of stress, and equations of elasticity—give the underlying theory essential to an understanding of the remaining chapters. These deal with extension, torsion, and flexure of beams; plane problems; three-dimensional problems; and variational methods. The latter chapter includes a discussion of the methods of finite differences and relaxation. In the present edition, a great part of the material in the last three chapters is new, and changes have been made throughout to take into account recent advances in theory.

THE MATHEMATICS OF PHYSICS AND CHEMISTRY. By Henry Margenau and G. M. Murphy. Second edition, D. Van Nostrand Company, Inc., Princeton, N. J. 604 p., 6⅛ × 9¼ in., bound. $7.95. For the most part, the chapters of this book each treat a single mathematical method in a systematic manner and with the degree of rigor customary in careful scientific demonstrations. The topics dealt with include partial differentiation as used in thermodynamics; ordinary and partial differential equations; vector analysis; matrices and matrix algebra; quantum mechanics; statistical mechanics; and numerical calculations. Fully worked examples are often used to illustrate the theory under discussion.

MESSUNGEN DES TEMPERATUR UND GESCHWINDIGKEITSFELDES BEI FREIER KONVEKTION. By Werner Kraus. 1955, Verlag G. Braun, Karlsruhe, Germany. 147 p., 5⅞ × 8⅜ in., bound. 18.60 DM. A systematic review of the literature on the measurement of temperature and velocity fields by free convection (particularly in gases): Introduction; test methods; point-by-point measurement of temperature fields; Schlieren and interference methods; measurement of velocity fields; worked-out examples; bibliography.

NUMERICAL ANALYSIS. By Zdenek Kopal. 1955, John Wiley & Sons, Inc., New York, N. Y. 556 p., 5½ × 8¾ in., bound. $12. The main subjects dealt with in this book are polynominal interpolation; numerical differentiation and integration; the solution of ordinary differential equations of any order or degree for initial-valve problems; and the solution of linear differential equations of any order for boundary-valve problems. The book also contains an introduction to the study of mechanical quadratures and their applications in the numerical solution of integral and integro-differential equations. The aim of the book is to develop the analytical basis of numerical processes used in the solution of problems of the infinitesimal calculus encountered in physics and engineering.

PLASTICS PROGRESS 1955. Papers and Discussions at the British Plastics Convention, 1955. Edited by Phillip Morgan. 1956, Philosophical Library, Inc., New York, N. Y., 432 p., 6 × 9¾ in., bound. $17.50. Recent developments in many fields of plastics technology are covered in papers grouped under the following headings: Polymer structure and properties; expanded plastics; thermoplastics; extrusion; work study and productivity; injection molding; patents; foundry resins; and glass-reinforced plastics.

POWER SYSTEM PLANT. Edited by E. Openshaw Taylor. 1955, George Newnes Limited, London, England, Available in the U. S. from Transatlantic Arts, Inc., Hollywood-by-the-Sea, Florida. 307 p., 5½ × 8¾ in., bound. $7.25. Based on a series of lectures for advanced students and practicing engineers, this book consists of eight chapters, each by an engineer closely connected with the theory or practice of the subject covered. The book deals with synchronous machines of the salient-pole and nonsalient-pole type; load, frequency, and excitation control of synchronous machines; and transformers, reactors, and voltage regulators. Two chapters are devoted to switchgear principles and practices, and two to underground cables and overhead lines.

ASME Boiler and Pressure Vessel Code

Interpretations

THE Boiler and Pressure Vessel Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting January 13, 1956, and approved by the Board on March 23, 1956.)

Case No. 1214

(Special Ruling)

Inquiry: Is it permissible in welded construction conforming to the requirements of Section VIII of the Code to use alloy steel plate conforming to the requirements of Specification SA-212, Grade B, except that the chemical and physical requirements are as follows:

CHEMICAL REQUIREMENTS	PER CENT
Carbon, max.	0.12
Manganese	0.50–1.00
Phosphorus	0.06–0.12
Sulfur, max.	0.05
Silicon	0.10–0.50
Chromium	0.40–1.00
Nickel	0.25–0.75
Copper	0.30–0.70

PHYSICAL REQUIREMENTS	UP TO ¾″ THICKNESS	OVER ¾″ TO 1½″
Tensile strength, min., psi	70,000	67,000
Yield point, min., psi	50,000	46,000
Elongation in 8 in., min., per cent	18[a]	19[b]

[a] For material under ⅝ in. in thickness, a deduction from the percentage of elongation in 8 in. specified above of 1.25 per cent shall be made for each decrease of 1/32 in. of the specified thickness below ⅝ in.

[b] For material over ¾ in. in thickness, a deduction from the percentage of elongation in 8 in. specified above of 0.50 per cent shall be made for each increase of ⅛ in. of the specified thickness above ¾ in. This deduction shall not exceed 3 per cent.

Reply: It is the opinion of the Committee that the material specified in the Inquiry may be used in the construction of welded pressure vessels under the rules of Section VIII of the Code provided the following additional requirements are complied with:

(1) The maximum thickness of shell and head plates shall be 1½ in.

(2) The maximum operating temperature shall not exceed 650 F.

(3) The maximum allowable stress value shall be one fourth of the specified minimum tensile strength.

(4) The completed vessel shall be stress-relieved.

(5) All main welded joints shall be of the double welded butt type or its equivalent.

(6) All welded butt joints shall be fully radiographed.

(7) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX. A separate welding procedure shall be made for this material.

ASME News

With Notes on the Engineering Profession

E. S. Newman, *News Editor*

WHAT OF TOMORROW?

A Message to ASME Student Members

By J. W. Barker

President, The American Society of Mechanical Engineers

MECHANICAL-ENGINEERING students of today are members of an exceptionally fortunate group. But this very fact may lead easily to unhappy individual failures in later life. What do I mean by this paradox? And why do I speak on these points?

When we speak of a "group" we are speaking statistically. When we say that a particular graduating class has had outstanding academic grades we are comparing the "average" or "median" grade of the class with the average or median of other preceding classes. We do not necessarily mean that every individual in the class has had higher grades than any individual in any preceding class. So let us discuss this statistically.

Law of Supply and Demand

For possible success in the profession a number of independent factors have large significance. Among these independent factors there are at least two which affect the success of the group as a whole—(1) the degree and nature of the competition for advancement to higher responsibilities in the profession, and (2) the openings or potential opportunities for advancement. You will immediately recognize this as a restatement of the law of supply and demand.

Supply

Let us look first at the "supply"—the competition your group will face. You were born somewhere between 1934 and 1937, in general. At this period the birth rate was low, and hence, statistically, your age group is somewhat small over-all. In addition, for the past five years there has been a declining percentage of college entrants who have elected engineering as a study career. Hence not only is your age group small in total numbers but the engineers in your age group are a lower percentage of the age bracket. It then seems obvious that *amongst yourselves* you will not face the extreme competition for advancement which older generations of engineers had to face.

Furthermore, the age groups just ahead of you were also small—the decline in the birth rate began in the early years of the great depression. And going back only some ten years in age groupings, don't forget the World War II and Korean War casualties which further reduced these age groups. But you may say, and correctly, that engineering graduations of, say, five to seven years ago were large. This was the result of the wave of World War II veterans whose engineering education from 1941 to 1945 was interrupted by the war, superimposed on those normally entering engineering school. Those war years of 1941–1945 had abnormally low engineering graduations.

Hence our curve of supply of engineering graduates since 1940 has seen a dip from 1942 to 1946, a small hump from 1947 to 1950, and another dip from 1951 to date. This dip will continue for at least two more years since entrants to engineering schools in 1953 and 1954 continued at the low rates of 1950, 1951, and 1952. This past fall (1955) saw the first real increase—but still it was a small one—in the number of engineering freshmen.

Looking then just ahead of you in the professional-age brackets, you find little competition and behind you, for at least two more years, also little competition. But little competition among yourselves and with your immediately adjacent age brackets may mean nothing fortunate unless there is a demand for engineering services. What is the situation in this second important group factor?

Demand for Engineers

I need say only a little about "demand"—the newspaper advertisements and the industrial recruiting parties on every engineering campus speak for themselves. In all my experience, I have never seen anything comparable to this demand for engineers and scientists! It is accepted that we have an accumulated shortage of over 50,000 engineers and scientists. Is this a "flash in the pan"? Will there be a glut of engineers in future years? Can this demand continue? All these questions must be coursing through your minds.

Still looking at these questions statistically, let me say that every business indicator, plus most economists' reports, show that our Gross National Product is leveling off at an annual rate of 400 billion dollars—the highest rate in history. There are indications that next year's rate may be slightly lower but not significantly so. Of course, some of this prosperity is the effect of defense production—here your guess as to the continuation of the "cold war" is just as good as mine.

Effect of Gross National Product Drop

But should the rate of Gross National Product drop somewhat more than presently expected, what would this do to you *as a group*? I believe little and I'll try to give you my reasoning. First, the accumulated shortage of engineers in industry, even though it may shrink somewhat in a business recession, still leaves a very large cushion for employment and promotion for your group. Second, every industry desires to maintain its engineering staff with reasonable age distribution and there are those "dips" ahead of you of which I have already spoken. Third, our amazing industrial production is predicated as never before upon technological developments—and these are precisely your field. Fourth, the engineering applications of new scientific discoveries are opening completely new areas of industry and power production, and again these are your field. Fifth, the continuing struggle to maintain mass production at reasonable consumer prices in the face of rising labor costs is leading to increasing automation—and again this is your field. And lastly, although this is out of my field, the economists tell us that there are "built-in stabilizers" in our present laws which will cushion any recession from becoming a depression such as that of the thirties'.

If I have correctly analyzed the technological probabilities and if our economists are even reasonably correct, you as engineers have little to fear *as a group*. As an individual member of your group, you will participate in the unusually fortunate *opportunities* for the entire group as its moves into the partial vacuum

created in our profession by the years of demand exceeding supply. Note that I have said the "fortunate *opportunities*." Where you, as an individual, will stand in the group after, say, ten or twenty or thirty years will depend solely upon how effectively you continue to build your professional capacity to assume more and more advanced responsibilities in your profession.

This has always been true—even when there were few vacancies ahead. But now the professional advancement will come to him who builds *most rapidly* his capacity to assume advanced responsibilities.

Build Professional Capacity to Succeed

How does a young practicing engineer build that professional capacity to succeed? It is an oft-repeated cliché that "education is a process that ceases only with death and that intellectual decay sets in when education ceases." But how will you know what to study in this continuing educational process? In college the curriculum prescribed what you *had* to study. Now, there will be no curriculum—you will be "on your own."

Certainly your job will determine the major line of study. You will find that you know—or maybe I had better say you have been introduced to—the rudiments, the basic principles applicable to your work. But you will have to learn how to apply these principles to the particular job at hand. This is "on-the-job training" and I want to stress its primary importance to your possibilities of advancement. Until you have gained mastery of the technological background of your job and that of the man ahead of you, you are not prepared for advancement.

However, it is not enough to learn how your particular company develops these particular principles—you nor your company want to get into an inbred rut. What are others doing in similar problems? Are there other methods or other applications? Are there other principles in the vast pool of scientific discoveries which could have application to some aspect of the problems at hand? All these must enter into your individual advanced-curriculum planning. Of course, I am assuming—and justifiably so—that you want to progress as rapidly as your capacities can be enlarged into those higher responsibilities which are wide open ahead of your group; that you want and intend to be one of the leaders in your group.

Let's use a familiar college situation as an analogy. The football coach spends hours and hours drilling his squad on the fundamentals of blocking, tackling, passing, kicking, and so on. He scrimmages his squads to drill them on the various plays until the particular signal called by the quarterback automatically induces the proper motion of each member of the team. He has skull practice to plan the strategy for the coming game. But he also has had the opponents scouted. What are the strengths and weaknesses of their attack and defense? What formations are they planning to use in particular circumstances?

So, too, must you coach your own individual training—fundamentals, applications, improvements—for the job at hand. And you must scout what does your boss have in the way of professional capacities which makes him a success in his job. And you should known what your opposite number in your competitors' team is doing, what his boss has that yours doesn't, and so on. And to carry the analogy one step farther, is there a new split-tee formation which no one has yet used, but the introduction of which might swing the game from losing to winning? Has some scientist researched a new concept that has possibilities for you and your company to win the competitive market?

How does a young graduate engineer find these opportunities? How does he get to be known professionally—not only in his own company but among his colleagues in other companies? How does he "scout his opposition?" How does he find out what new areas of study are most apt to have important possibilities for his future advancement? How does he find out whether the company with which he took his job and which is training him in its own methods and applications is ahead of, just equal to, or behind the competition? How does he find out if there are more attractive possibilities for his peculiar capacities in some other company?

"Active" Membership in ASME

These are, to me, just what active membership in The American Society of Mechanical Engineers offers to the junior engineer. And let me stress that word—active. Just transferring from your student member into an associate member on graduation is *not* enough. Just casually reading MECHANICAL ENGINEERING each month is not *enough*. Just passively attending ASME meetings is not enough. I don't have to tell you that merely attending classes in Thermo has not given you a grasp on the subject—you had to study hard, you had to work problems, before you could master the subject.

No, preparation for rapid technological advancement requires, first of all, that you become expert in every detail of the assignment at hand. Here, the Professional Division activities of the ASME offer you untold possibilities. In the Divisional Conferences and in the sessions at National Meetings sponsored by the Division, you will find the latest technical advances and the most up-to-date technical thinking set forth by the outstanding leaders in your field. These papers and their cited references should be principal texts for your advanced study. Here are the best suggestions upon which you can formulate your own curriculum. Rigorous study of such papers will disclose to you any weaknesses in mastery of fundamentals, It will point the way to advanced studies, in pure science, shown to have applications in your field of technology.

Studying by yourself is excellent but attendance at Section or Division Conference meetings offers the additional advantage of participating in the formal or, often of more import—the informal discussions about the presented papers. It is a crude comparison but just studying the paper by yourself is something like hearing the professor lecture on the subject. Joining the discussion is like the classroom or seminar, where the group gains mastery of the principle involved and argue about alternatives. Even if you cannot attend the Divisional conferences, you can seek out other juniors in your company or in the ASME Section interested in the same field and discuss the papers among yourselves—in other words, organize your own seminar. In our larger ASME Sections you will find organized discussion groups. If there isn't one in your own field, be a leader and try to organize one.

Our Professional Divisions have many committees, working on particular subdivisions of the field covered by the Division. Look up these committees in the ASME Membership List, AM 1-Biennial, or ASME Publication AC-10, "Personnel of Council, Boards, and Committees." Write to the chairman, saying you are interested in this particular area and would like to be assigned to his committee or subcommittee and are willing to do some work.

Most of the technical work of the ASME is carried on in the Professional Divisions or in the associated Research Committees. But another most important area for the young engineer to cultivate is performed by our Sections. As soon as you settle down in your first job, join the ASME Section, attend its meetings, and meet your fellow mechanical engineers from all the industries of your region.

Here, too, you will find opportunities for active work in the group and here you will find opportunities for making friends with people of like interests. Don't be afraid of the older engineers; introduce yourself to them. You will find them as anxious to know you as you are to know them. Among them, you will find experts in the field who will be glad to discuss technical questions with you.

When the Section Program Committee has secured a speaker in the area in which you are primarily interested, make an opportunity to meet him either before, or, preferably, after his talk. He is an expert in your field and intelligent discussion with him can be nothing but helpful to you. Time and effort spent in forming acquaintanceships in your field can be a valuable asset. Becoming convinced of your interest and your capabilities in his field may lead to his asking you to be a formal discusser of his next paper at a Divisional or Society meeting. Such an invitation may lead to your company sending you to that meeting, if you have worked up some worth-while discussion. Get to be known—but, for heaven's sake—don't be a "pesterer." If you have nothing worth while to say to a speaker, don't pester him. If you haven't some intelligent discussion to offer on a paper, don't get to your feet.

Why Join a Professional Society?

When I resigned my Army commission after World War I, my chief put society membership to me this way. He said that my family and I had made quite a sizable investment in my technical education. If I were to realize the maximum return on that investment I had to continue to plow back into my professional career some part of my earnings. Just as a progressive industry doesn't declare its entire net earnings as dividends but plows back a

part into additional plant and equipment, so should I not only join my professional society, but I should attend its principal meetings. Unless I had accepted for presentation a technical paper or was a member of an important committee, I wouldn't go on an expense account, but I ought to go anyway, charging my expenses as part of this reinvestment. Secondly, the fact that I couldn't get my expenses paid unless I had an accepted paper or was on a most important committee, put the bee on me to really enter wholeheartedly into Society activities. I did so, and I have never regretted it—frankly, the reinvestment has paid handsome dividends in my case. It can do so for you if you are willing to "put out"—not just to get a "free ride."

ASME's Role in Professional Development

Active participation in ASME in all its phases can be a most important part of your total future professional development. It can offer you opportunities to build your technical competence for promotion. It can widen your horizons, both in technology and in reputation in the field. It offers you possibilities for many friendships among kindred souls. It offers you opportunities for rewarding service, both technical and civic. It is your Society—you can make it of even greater importance to our country—you can make it of even greater importance to those who will follow you up the path of professional advancement.

Let me sum up. Tomorrow holds exceptional opportunities for you young engineers as a group. A rapidly growing technological industry has a shortage of engineers. There are great openings ahead. There are new industries being, and to be, formed to bring scientific advances into commercial production. There are older industries to be re-engineered and re-equipped to meet increasing consumer demands in the face of increased labor costs.

As your group surges forward, there will be, as always, individuals who will outpace the group. These individuals will be those who deliberately spend time and energy to develop their capacity for new responsibilities most rapidly and most competently.

In this Tomorrow, the ASME can be of great importance to its members. Shouldn't you maintain your membership? Shouldn't you participate most actively in the Society? Shouldn't you make the ASME of ever greater helpfulness to its members? And, finally, through ASME—shouldn't you make the Engineering Profession of ever greater usefulness to our country and to our Western Civilization?

More Effective Engineering Management Topic of ASME West Coast Meeting

The Southern California Section of The American Society of Mechanical Engineers is sponsoring a West Coast Engineering Management Conference to be held May 14 and 15 at the Hotel Statler, Los Angeles, Calif.

The theme, "More Effective Engineering Management—Today and Tomorrow" will keynote the conference. The technical program will be presented in four sessions, including such pertinent topics as planning and control of complex engineering projects, intelligent use of engineering talent, enlarging the engineer's future, and current administrative trends.

Two luncheons and a banquet will round out the program. The principal speakers at the luncheons are M. P. O'Brien, dean of the College of Engineering, University of California at Berkeley, and W. L. Chadwick, vice-president—engineering, Southern California Edison Company. A. C. Hall, general manager, Research Division, Bendix Aviation Corporation, one of the three ASME members who recently visited Russia, will speak on "Progress in Automation in the USSR."

The tentative program follows:

SUNDAY, MAY 13

3:00 p.m. — **Ballroom Floor**

Registration

MONDAY, MAY 14

8:00 a.m. — **Dallas Room**

Authors' Breakfast

8:00 a.m. — **Ballroom Floor**

Registration

9:30 a.m. — **Sierra Room**

Session 1

Planning and Control of Complex Engineering Projects

Chairman: *F. J. Fontana*, vice-chairman, Southern California Section, ASME.

Vice-Chairman: *J. O. Philips*, Vernon Works, Aluminum Company of America

Planning and Control of New-Product Development, by *R. W. Jones*, Booz, Allen & Hamilton

Planning and Control of Engineering for Major-Construction Projects, by *I. R. Caraco*, Power Division, Bechtel Corp.

Organization and Control of a Complex Research and Development Project, by *M. E. Mohr*, Control Systems Division, The Ramo-Wooldridge Corp.

12:15 p.m. — **Los Angeles Room**

Luncheon

Presiding: *B. T. McMinn*, Vice-President, Region VII, ASME

Speaker: *M. P. O'Brien*, College of Engineering, University of California, Berkeley

2:30 p.m. — **Sierra Room**

Session 2

Intelligent Use of Engineering Talent

Chairman: *N. S. Houston*, North American Aviation, Inc.

Vice-Chairmen: *R. A. Dutton*, AiResearch Manufacturing Co., and *P. W. Spinner*, Richfield Oil Corp.

Use of Technical Manpower for Technical Problems Only, by *W. L. Collins*, Western Operating Division, Standard Oil Company of California

Productivity and Stability in Research-Development Teams, by *W. A. Casler*, Stanford Research Institute

6:00 p.m. — **Los Angeles Room**

Social Hour

7:00 p.m. — **Golden State Room**

Banquet

Presiding: *J. Calvin Brown*, past-president and Fellow ASME

Speaker: *Albert C. Hall*, general manager, Research Division, Bendix Aviation Corp.

Subject: **Progress in Automation in the USSR**

TUESDAY, MAY 15

8:00 a.m. — **Dallas Room**

Authors' Breakfast

8:00 a.m. — **Ballroom Floor**

Registration

9:30 a.m. — **Sierra Room**

Session 3

Enlarging the Engineer's Future

Chairman: *G. D. Christensen*, assistant to the vice-president—engineering, Convair, a Division of General Dynamics Corp.

Vice-Chairman: *F. B. Clark, Jr.*, manager of industrial relations, Weber Aircraft Co.

Engineers in Top Management, by *W. T. Powell*, Emsco Manufacturing Co.

The Challenge, by *N. F. Parker*, Autonetics, a Division of North American Aviation, Inc.

Opportunities and Responsibilities for the Engineer Who Wants Advancement, by *R. E. Vivian*, University of Southern California

12:15 p.m. — **Golden State Room**

Luncheon

Presiding: *R. M. Hatfield*, chairman, Southern California Section, ASME; vice-president, Combustion Engineering, Inc.

Speaker: *W. L. Chadwick*, vice-president—Engineering, Southern California Edison Co.

Subject: **The Engineer—Technician or Leader**

2:30 p.m. — **Sierra Room**

Session 4

Current Administrative Trends

Chairman: *F. L. Graham*, management consultant

Vice-Chairman: *D. D. Acker*, assistant to the applications manager, Autonetics, a Division of North American Aviation, Inc.

Present Status of National Military-Manpower Legislation—Its Implications to Management, by *W. T. Cavanaugh*, executive secretary, Engineering Manpower Commission, Engineers Joint Council

Qualifications for Today's Sales Engineer, by *V. A. Peterson*, Elliott Co.

5:00 p.m. — **Dallas Room**

Management Division Business Meeting

Do You Want Latest Lubrication Information?

The newly formed Lubrication Division of The American Society of Mechanical Engineers has as one of its objectives the dissemination of new and reliable data; new ideas on the best practices in the design of lubrication systems and new methods for solving the problems of bearing designs. Lubrication has become a dynamic and changing field.

Actually, more lubrication research is currently in progress than at any other period in the machine age. The need to lubricate bearings and gears at ever-increasing loads, speeds, and temperature has forced many and varied research programs envolving basic fundamentals as well as the development of design data and methods and lubricants.

Register with the Lubrication Division to keep abreast of what is new in lubrication, to receive material distributed by the Division, and notices of meetings that the Division sponsors. To register interest in Lubrication Division activities, among those in which you are registered, please notify the Secretary's Office. A convenient form for this purpose will be found on page 502 of this issue.

Aerial view shows the Eastlake power plant of The Cleveland Electric Illuminating Company. The plant is located 20 miles east of downtown Cleveland, on the south shore of Lake Erie at the mouth of the Chagrin River. It is the company's newest power producer and ranks among the most efficient steam-generating stations in the country. Three 140,000-kw turbo-generators are now in use; a fourth unit of 240,000-kw capacity went into service in mid-March of this year. Its planned ultimate capacity of more than 1,000,000 kw will cost in excess of $125 million. This plant is to be visited during the ASME Semi-Annual Meeting to be held at the Hotel Statler, Cleveland, Ohio, June 17–21.

1956 ASME Semi-Annual Meeting Program to Highlight Engineering Advances, Cleveland, June 17–21

D. F. Galloway, Director of Research, Production Engineering Research Association of Great Britain, to deliver Rice Lecture

THE 1956 Semi Annual Meeting of The American Society of Mechanical Engineers will be held at the Hotel Statler in Cleveland, Ohio, from June 17 to 21. The American Rocket Society, an affiliate of the Society, will present its program concurrently in four technical sessions.

The technical papers, which will be presented in some forty sessions, are contributed through the Society's Professional Divisions and cover such fields as Power, Hydraulics, Heat Transfer, Gas Turbine Power, Machine Design, Instruments and Regulators, Rubber and Plastics, Education, Aviation, and others.

The tentative program follows:

SUNDAY, JUNE 17

2:00 p.m.

Registration

4:00 p.m.

Social Hour

6:30 p.m.

Musicarnival—"The King and I"

Arrangements have been made for ASME members and guests to attend a performance of the entertaining Rodgers and Hammerstein musical, "The King and I" at Musicarnival, America's most luxurious tent theatre, located 11 miles southwest of downtown Cleveland. After the performance, you will have coffee with the cast, as a special treat for ASME.

MONDAY, JUNE 18

8:00 a.m.

Registration

9:30 a.m.

Power (I)

Properties of Steam at High Pressures—An Interim Steam Table, by *R. C. Spencer, Jr.*, General Electric Co., *C. A. Meyer*, Westinghouse Electric Corp., and *R. D. Baird*, Allis-Chalmers Manufacturing Co. (Paper No. 56—SA-33)

Predicting Performance of Large Steam-Turbine-Generator Units for Central Stations,[1] by *Henry Hegetschweiler* and *R. L. Bartlett*, General Electric Co. (Paper No. 56—SA-52)

9:30 a.m.

Hydraulic (I)—Machine Design (I)

Hydraulic-Accumulator Applications[1]

Reducing Power Consumption in Hydraulic Circuits[1]

9:30 a.m.

Heat Transfer (I)—Gas Turbine Power (I)

Generalized Optimal Heat-Exchanger Design, by *D. H. Fax*, Westinghouse Electric Corp., and *R. R. Mills, Jr.*, The Johns Hopkins University (Paper No. 56—SA-19)

Tests of Free Convection in a Partially Enclosed Space Between Two Heated Vertical Plates, by *R. Siegel*, NACA Lewis Flight Propulsion Laboratory, and *R. H. Norris*, General Electric Co. (Paper No. 56—SA-5)

[1] Paper not available—see box on page 476.

9:30 a.m.

Rubber and Plastics (I)

High-Impact Plastics as Engineering Materials[1]

Weather Aging of Colored Styrene Plastics[1]

The Properties and Applications of Martex 50 Ethylene Polymer[1]

"Zytel" Nylon Resins—A Versatile Engineering Material[1]

9:30 a.m.

American Rocket Society (I)

Ramjet Session

The Ramprop, a Supersonic Jet-Driven Propeller,[2] by *Albert Gail*, Cornell Aeronautical Laboratory, Inc. (Paper No. ARS—296–56)

The LeDuc 022 Ramjet Airplane,[2] by *Rene LeDuc*, LeDuc et Fils, Paris, France (Paper No. ARS—297–56)

Some Fundamental Aspects of Ramjet Propulsion,[2] by *A. N. Thomas, Jr.*, Marquardt Aircraft Co. (Paper No. ARS—298–56)

12:15 p.m.

President's Luncheon

Speaker: *J. W. Barker*, ASME President
Subject: **1956—The Biggest Year Yet**

2:30 p.m.

Power (II)

Supercritical Addition to Avon Station[1]

Effect of Internal Pressure on the Flexibility and Stress-Intensification Factors of Curved Pipe or Welding Elbows, by *E. C. Rodabaugh* and *H. H. George*, Tube Turns, Division of National Cylinder Gas Co. (Paper No. 56—SA–50)

2:30 p.m.

Hydraulic (II)—Gas Turbine Power (II)

Analysis of Incompressible, Nonviscous Blade-to-Blade Flow in Rotating Blade Rows[1]

The Effect of the Volute on Performance of a Centrifugal-Pump Impeller, by *R. D. Bowerman* and *A. J. Acosta*, California Institute of Technology (Paper No. 56—SA–45)

2:30 p.m.

Heat Transfer (II)

A Novel Method of Obtaining an Isothermal Surface for Steady-State and Transient Conditions, by *G. N. Hatsopoulos* and *J. Kaye*, Massachusetts Institute of Technology (Paper No. 56—SA–13)

A Mechanical Computing Device for the Analysis of One-Dimensional Transient Heat-Conduction Problems, by *W. E. Howland, E. A. Trabant*, and *G. A. Hawkins*, Purdue University (Paper No. 56—SA–27)

Study of Heat Transfer to Liquid Nitrogen, by *L. E. Dean*, Aerojet-General Corp., and *L. M. Thompson*, Bell Aircraft Corp. (Paper No. 56—SA–4)

2:30 p.m.

Machine Design (II)

An Application of Complex Geometry to Relative Velocities and Accelerations in Mechanisms, by *G. H. Martin*, Michigan State University, and *M. F. Spotts*, Northwestern University (Paper No. 56—SA–32)

Geometry of Belt and Chain Drives, by *J. D. Howell*, Kearney & Trecker Corp. (Paper No. 56—SA–41)

2:30 p.m.

Rubber and Plastics (II)

Properties and Applications of Silicone Rubber, by *S. A. Braley, Jr.*, Dow Corning Corp. (Paper No. 56—SA–53)

Properties and Application of Coral Rubber—A CIS 1, 4 Polyisoprene[1]

Polyurethane Rubber as a Material of Construction for Industrial Rubber Products[1]

2:30 p.m.

Education

How Should Engineering-Design Fundamentals Be Treated in a Mechanical-Engineering Curriculum[1]

Teaching Machine Design for Modern Industry[1]

Thermodynamics in Engineering Science[1]

[1] Paper not available—see box on this page.
[2] ARS Papers may be obtained by writing to American Rocket Society, 500 Fifth Avenue, New York 36, N. Y.

Orders for Technical Papers

ONLY copies of *numbered* ASME papers will be available. Some of these papers may not be available in time to permit your receiving them in advance of the meeting. Your order will be mailed only when the complete order can be filled unless you request that all papers available ten days before the meeting be mailed at that time. Please order only by paper *number;* otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the meeting.

Copies of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten, are $2 for members; $4 for nonmembers.

Copies of unnumbered papers, listed in the program, *are not available* because the review of these manuscripts had not been completed when the program went to press. The author's name and paper number will appear with paper title in the final program (final program available only at meeting) as well as the issue of MECHANICAL ENGINEERING containing an account of the meeting, if the paper has been recommended for publication in pamphlet form.

2:30 p.m.

American Rocket Society (II)

Liquid Propellant Rocket Session

Dynamics of a Variable-Thrust, Pump-Fed, Bi-Propellant, Liquid-Rocket-Engine System,[2] by *M. R. Gore* and *J. J. Carroll*, Aerojet-General Corp. (Paper No. ARS—299–56)

Hydrogen Peroxide as a Monopropellant or Oxidant for Aircraft Propulsion,[2] by *A. J. Kubica* and *J. C. McCormick*, Food Machinery & Chemical Corp. (Paper No. ARS—300–56)

A Solid-Liquid-Rocket Propellant System,[2] by *G. E. Moore* and *Kurt Berman*, General Electric Co. (Paper No. ARS—301–56)

An Evaluation of Various Liquid-Rocket Exhaust Jet-Flame Suppressants,[2] by *J. C. Becker, Jr.*, Aerojet-General Corp. (Paper No. ARS—302–56)

4:45 p.m.

Business Meeting

Presiding: *Joseph W. Barker*, ASME President
Announcement: **Location of 1957 Semi-Annual Meeting**
Election: **Nominating Committee for 1957**

This Business Meeting of the members provides an opportunity for a free discussion of Society policies and procedures and all members are urged to attend.

7:00 p.m.

American Rocket Society Dinner

8:00 p.m.

National Junior Committee

TUESDAY, JUNE 19

8:00 a.m.

Registration

9:30 a.m.

Hydraulic (III)

Pressure Drop and Flow Characteristics of Short Capillary Tubes at Low Reynolds Numbers, by *Frank Kreith*, Lehigh University, and *R. Eisenstadt*, Union College (Paper No. 56—SA–15)

Orifice-Metering Coefficients and Pipe-Friction Factors for the Turbulent Flow of Lead-Bismuth Eutectic, by *H. A. Johnson*, University of California, *J. P. Hartnett*, University of Minnesota, *W. J. Clabaugh* and *Lawrence Fried*, General Electric Co. (Paper No. 56—SA–16)

9:30 a.m.

Heat Transfer (III)—Aviation (I)

The Thermal Problems of High-Speed Flight and the General Electric Aircraft-Cooling Program, by *J. W. Rizika*, General Electric Co. (Paper No. 56—SA–24)

A Survey of Possible Refrigerants for High-Temperature Application, by *Jon Van Winkle*, General Electric Co. (Paper No. 56—SA–12)

A Comparison of Refrigerants When Used in Vapor-Compression Cycles Over an Extended Temperature Range, by *J. P. Barger, W. M. Rohsenow*, Massachusetts Institute of Techology, and *K. M. Treadwell*, Westinghouse Electric Corp. (Paper No. 56—SA–6)

Turboconditioning Systems With Vapor-Compression Cycles, by *J. P. Barger, W. M. Rohsenow*, Masschusetts Institute of Technology, and *K. M. Treadwell*, Westinghouse Electric Corp. (Paper No. 56—SA–7)

9:30 a.m.

Machine Design (III)—Instruments and Regulators (I)

Viscous-Damper Design Refinements for Servomechanisms, by *E. J. Hayes*, The Johns Hopkins University (Paper No. 56—SA–40)

Alignment Diagrams From Network Charts by Graphics, by *D. P. Adams*, Massachusetts Institute of Technology (Paper No. 56—SA–39)

Cost Criteria of Design Change in Industrial Products, by *J. E. Ullmann*, Bulova Research & Development Labs., Inc. (Paper No. 56—SA–42)

9:30 a.m.

Process Industries—Air-Pollution Controls (I)

Infrared Gas Analyzers for the Process Industries[1]

A Deceleration Probe for Measuring Stagnation Pressure and Velocity of a Particle-Laden Gas Stream[1]

Research Progress on Open-Hearth Furnace-Fume Control[1]

9:30 a.m.

Production Engineering (I)—Metal Processing (I)

Experimental Investigations of the Influence of Various Factors on Drill Performance[1]

9:30 a.m.

American Rocket Society (III)

Solid-Propellant Rocket Session

Launching Solid-Propellant Rockets From Shipboard Installations,[2] by *J. F. R. Floyd*, The Johns Hopkins University (Paper No. ARS—311–56)

Importance of Mass Ratio and Adaptability of Case-Bonded Solid-Propellant Rocket Systems for Achievement of Super Velocities,[2] by *J. W. Wiggins*, Thiokol Chemical Corp. (Paper No. ARS—303–56)

Cold-Forming Methods for Fabrication of Inert Rocket Components During Development,[2] by *H. R. Grant*, Aerojet-General Corp. (Paper No. ARS—304–56)

Design of Long-Range Ballistic Vehicles,[2] by *P. J. Blatz*, Aerojet-General Corp. (Paper No. ARS—305–56)

9:30 a.m.

Power (III)

A New Way to Simplify the Steam-Power Plant, by *H. A. Kuljian* and *W. J. Fadden, Jr.*, The Kuljian Corp. (Paper No. 56—SA–34)

An Analytic Procedure for Optimizing the Selection of Power-Plant Components, by *W. A. Wilson*, Massachusetts Institute of Technology (Paper No. 56—SA–51)

Inspection Trips

10:00 a.m. National Malleable & Steel Castings Co.

2:00 p.m. Ford Motor Company's Cleveland Engine Plants

2:00 p.m. Combined trip to Republic Steel Corporation and U. S. Air Force Heavy Press Plant

2:00 p.m. The Warner & Swasey Co.

2:00 p.m. Standard Oil Company (Ohio)

2:30 p.m.

Heat Transfer (IV)—Aviation (II)

Influence of Through-Metal on Heat Transfer Through Aircraft-Structural Sandwich Panels, by *J. R. Woolf* and *L. R. Scott, Jr.*, Convair Division of General Dynamics Corp. (Paper No. 56—SA-23)

A Systematic Study of Air Cycles for Aircraft-Cooling Applications, by *L. R. Stevens, Jr.*, General Electric Co. (Paper No. 56—SA-11)

2:30 p.m.

Machine Design (IV)

The New American Standard for Surface Roughness, Waviness, and Lay, by *D. V. Kelly*, General Motors Corp. (Paper No. 56—SA-48)

Ultrasonic Impact Grinding, by *P. J. Duran*, Raytheon Manufacturing Co. (Paper No. 56—SA-47)

Load-Carrying Capacity of Spur Gear-Teeth Hob Cut From Molded Du Pont "Zytel" 101, by *K. W. Hall* and *H. H. Alvord*, University of Michigan (Paper No. 56—SA-43)

2:30 p.m.

Production Engineering (II)

Analysis of Manufacturing Costs Relative to Product Design, by *L. J. Bayer*, The Warner & Swasey Co. (Paper No. 56—SA-9)

Production Surfacing of Aluminized Engine Valves, by *J. A. Newton* and *M. D. Braid*, Thompson Products, Inc. (Paper No. 56—SA-35)

2:30 p.m.

Fuels (I)—Air-Pollution Controls (II)

Incinerator Session

Design of Municipal Incinerators: The Customer's View[1]

Municipal Incinerators: The Designer's View[1]

2:30 p.m.

Management

Why Is U. S. Industry Strong?, by *W. A. Hadley*, Mergenthaler Linotype Co. (Paper No. 56—SA-25)

The Selection of Technical Managers as Viewed by a Personnel Psychologist, by *A. Pemberton Johnson*, Newark College of Engineering (Paper No. 56—SA-10)

How to Analyze the Cost of Machine Tools From the Swivel Chair, by *Realf Otteson*, McCulloch Motors Corp. (Paper No. 56—SA-2)

2:30 p.m.

American Rocket Society (IV)

Satellite Flight Session

Instrumentation Problems of Unmanned Satellites,[2] by *Ernst Stuhlinger*, Redstone Arsenal (Paper No. ARS—306-56)

Effects of Meteor and Atom Bombardment on Satellite Skin,[2] by *S. Fred Singer*, University of Maryland (Paper No. ARS—307-56)

Lifetime of Artificial Satellites of the Earth,[2] by *I. G. Henry*, Aerojet-General Corp. (Paper No. ARS—308-56)

Satellite Communication Problems,[2] by *J. Jensen*, Glenn L. Martin Co. (Paper No. ARS—309-56)

The Solar-Powered Space Ship,[2] by *K. A. Ehricke*, Convair, Division of General Dynamics Corp. (Paper No. ARS—310-56)

5:00 p.m.

Calvin W. Rice Lecture

Presiding: *Joseph W. Barker*, ASME President

Speaker: *D. F. Galloway*, director of research, Production Engineering Research Association of Great Britain, Leicestershire, England

Subject: **Production-Engineering Research and Its Practical Application in Great Britain**

5:45 p.m.

ASME Baseball Night

Cleveland Indians versus Boston Red Sox. A delicious roast-beef buffet dinner will be served in the outfield of Cleveland's Municipal Stadium, home of the Cleveland Indians, to all members and guests of ASME.

[1] Paper not available—see box on page 476.

[2] ARS papers may be obtained by writing to American Rocket Society, 500 Fifth Avenue, New York 36, N. Y.

WEDNESDAY, JUNE 20

8:00 a.m.

Registration

9:30 a.m.

Student-Member Competition for 1956 Old Guard Prize

The names of six winners from Regional Student Conferences will appear in the final program after selection has been determined at conclusion of the last student conference on May 5.

9:30 a.m.

Production Engineering (III)

Industry Under Enemy Attack, by *B. W. Bruckmann*, General Electric Co. (Paper No. 56—SA-8)

The H-Bomb and Industry Defense, by *V. L. Couch*, Federal Civil Defense Administration (Paper No. 56—SA-3)

9:30 a.m.

Metal Processing (II)

Forces and Power Required to Turn Aluminum and Seven Alloys, by *O. W. Boston*, University of Michigan, and *W. W. Gilbert*, General Electric Co. (Paper No. 56—SA-14)

Comparative Machinability of B1113–C1213–C1120–HR-C1120D and C1119 Steels, by *H. L. Bryden*, University of Connecticut (Paper No. 56—SA-26)

9:30 a.m.

Aviation (III)

New National Facilities for Propulsion Research and Development

Test Facilities, Aeronautical Turbine Laboratory, U. S. Naval Air Turbine Test Station[1]

Propulsion Facilities at the Arnold Engineering Development Center[1]

Propulsion Wind Tunnel at NACA, Lewis Laboratory[1]

9:30 a.m.

Gas Turbine Power (III)—Machine Design (V)

Some Aspects of Rotating Stall in Single-Stage Compressors[1]

Design Criteria and Design of Radial and Mixed-Flow Impellers[1]

9:30 a.m.

Fuels (II)—Power (IV)

Fluid Coke Session

Multifuel Firing of Cyclone Furnaces[1]

Burning Fluid Coke[1]

9:30 a.m.

Heat Transfer (V)

Heat-Transfer Rates to Crossflowing Mercury in a Staggered Tube Bank, *by R. J. Hoe*, General Electric Co., *D. Dropkin*, Cornell University, and *O. E. Dwyer*, Brookhaven National Laboratory (Paper No. 56—SA-38)

Apparatus for Measuring the Thermal Conductivity of Liquids at Elevated Temperatures: Thermal Conductivity of Fused NaOH at 600 C, by *C. F. Lucks* and *H. W. Deem*, Battelle Memorial Institute (Paper No. 56—SA-31)

Inspection Trip

2:00 p.m. NACA, Lewis Laboratory

2:30 p.m.

Student-Member Competition for 1956 Old Guard Prize

The names of six additional winners from Regional Student Conferences will appear in the final program after selection has been determined at conclusion of the last student conference, May 5.

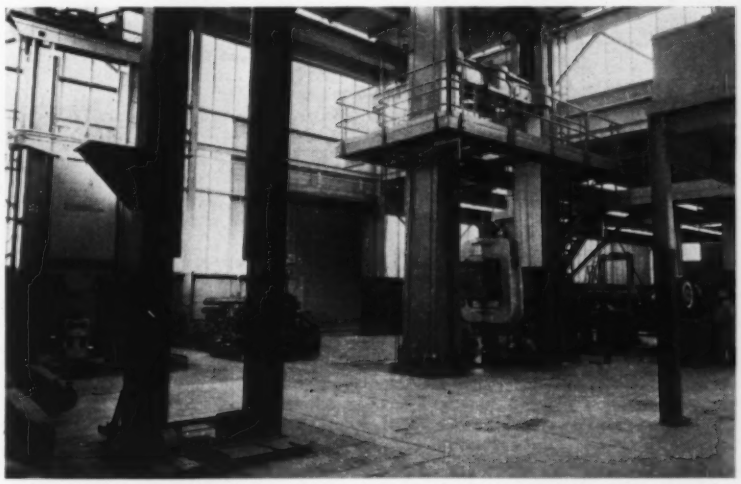
Official Notice

ASME Business Meeting

The Semi-Annual Business Meeting of the Members of The American Society of Mechanical Engineers will be held on Monday, June 18, 1956, 4:45 p.m., Hotel Statler, Cleveland, Ohio, as part of the Semi-Annual Meeting of the Society.

The program is planned to include the announcements of the location of the 1957 Semi-Annual Meeting and election of the Nominating Committee for 1957.

This Business Meeting of the Members provides an opportunity for a free discussion of Society policies and procedures and all Members are urged to attend.



View of National Malleable and Steel Castings Company Technical Center shows, *right center,* 1,000,000-lb hydraulic static test machine, *extreme left,* 27,000-lb tup dynamic (drop) test machine, and *left foreground,* 1640-lb and 4600-lb tup dynamic drop test machine. Many other test machines and large setups of electronic recording instrumentation available for examination will be on exhibit. An inspection trip to the Technical Center is scheduled during the ASME Semi-Annual Meeting to be held at the Hotel Statler, Cleveland, Ohio, June 17–21.

ASME National Nominations

THE 1956 Nominating Committee is to meet for two days, June 18–19, 1956, at the Hotel Statler in Cleveland, Ohio, where the Semi-Annual Meeting will be held. Open hearings will be held so that members may speak in behalf of their candidates for the office of President, Regional Vice-Presidents, and Directors any time between the hours of 10:30 a.m. to 12:00 noon; and from 2:00 p.m. to 5:00 p.m. on Monday, June 18, and on Tuesday, June 19, from 9:00 a.m. to 12:00 noon and, if necessary, from 2:00 p.m. to 5:00 p.m. Following the close of business of the 1956 Nominating Committee there will be held an Organization Meeting of the 1957 Committee presided over by H. B. Atherton, chairman of the 1956 Committee. This meeting will take place on Tuesday afternoon or evening, June 19, following the Business Meeting of the 1956 Committee or, if necessary to extend the Business Meeting through Tuesday evening, the Organization Meeting will be held on Wednesday morning, June 20.

2:30 p.m.

Production Engineering (IV)—Machine Design (VI)

Steps Toward More Creative Production Engineering, by *W. P. Smith*, Michigan State University (Paper No. 56—SA–49)

Statistics in Production Engineering[1]

2:30 p.m.

Metal Processing (III)

The Influence of Lead on Metal-Cutting Forces and Temperatures, by *M. C. Shaw* and *P. A. Smith*, Massachusetts Institute of Technology, *E. G. Loewen*, Taft-Peirce Manufacturing Co., and *N. H. Cook*, Massachusetts Institute of Technology (Paper No. 56—SA–36)

Force Relationships in the Machining of Low-Carbon Steels of Different Sulphur Contents, by *F. W. Boulger*, Battelle Memorial Institute, *H. E. Hartner*, *W. T. Lankford, Jr.*, and *T. M. Garvey*, U. S. Steel Corp. (Paper No. 56—SA–21)

Leaded Steel and the Real Area of Contact in Metal Cutting, by *M. C. Shaw*, *P. A. Smith*, and *N. H. Cook*, Massachusetts Institute of Technology, and *E. G. Loewen*, Taft-Peirce Manufacturing Co. (Paper No. 56—SA–37)

2:30 p.m.

Lubrication

Panel Session: Digesting the 1955 Literature on Bearings, Lubricants, and Lubrication Research

Journal Bearings, Thrust Bearings, Bearing Materials, by *O. Pinkus* and *B. Sternlicht*, General Electric Co.

Rolling-Element Bearings and Gears, by *P. Skerchock*, Sinclair Refining Co.

Boundary-Lubrication Studies, Metalworking Lubrication, by *S. J. Beanbien* and *N. H. G. Daniels*, Shell Development Co.

Automotive Lubricants and Properties of Lubricants, *H. A. Hartung*, Atlantic Refining Co.

2:30 p.m.

Gas Turbine Power (IV)—Power (V)

Problems Encountered in the Translation of Compressor Performance From One Gas to Another[1]

Facilities and Instrumentation for Compressor and Turbine Research at the NACA Lewis Flight Propulsion Laboratory[1]

2:30 p.m.

Safety

Planning for Safety, by *R. W. Mallick*, Westinghouse Electric Corp. (Paper No. 56—SA–30)

[1] Paper not available—see box on page 476.

Factors in Exhaust-Ventilation-System Design for the Safety Engineer[1]

7:00 p.m.

Banquet

Business Dress

THURSDAY, JUNE 21

8:00 a.m.

Registration

9:30 a.m.

Metal Processing (IV)—Metals Engineering—Machine Design (VIIA)

The Effect of Cold Work on the Elevated Temperature Properties of Types 301, 305, and 310 Stainless Steel, by *R. A. Lula*, *Adolph J. Lena*, and *H. M. Johnson*, Allegheny Ludlum Steel Corp. (Paper No. 56—SA–44)

Research and Vibration Control of an Internal Grinder With Welded Structure[1]

9:30 a.m.

Gas Turbine Power (V)

Research on Application of Cooling to Gas Turbines[1]

Considerations in the Development of Small Turbojet Engines[1]

9:30 a.m.

Materials Handling—Production Engineering (V)

Handling by Dragline—the Workhorse of Industry, by *H. J. McCormick*, Link Belt Co. (Paper No. 56—SA–38)

European Design Trends in Mechanical Materials Handling, by *H. W. Von Der Recke*, Hewitt-Robins, Inc. (Paper No. 56—SA-22)

Observations on Materials Handling in the Soviet Union, by *W. H. Brandt*, Westinghouse Electric Corp. (Paper No. 56—SA–29)

9:30 a.m.

ASME Research Activities

General Discussion

General Presentation on Aims and Objectives of the Society's Research Committees, by *T. H. Wickenden*, The International Nickel Co., Inc., and *G. M. Muschamp*, Minneapolis-Honeywell Regulator Co.

Organization and Operation of a Research Committee, by *S. R. Beitler*, The Ohio State University

Report of ASME Research Committee on Mechanical Pressure Elements:

(*a*) **History and Finances,** by *P. G. Exline*, Exline Engineering Co.
(*b*) **Progress on Diaphragms,** by *R. M. Conklin*, Battelle Memorial Institute
(*c*) **Progress on Bourdon Tubes,** by *J. R. Keim*, Minneapolis-Honeywell Regulator Co.
(*d*) **Future Research Plans,** by *S. G. Eskin*, The Dole Valve Co.

9:30 a.m.

Instruments and Regulators (II)—Machine Design (VIIB)

A Graphical Method for the Analysis of Piecewise Linear-Control Systems With Particular Application to Relay Controls, by *R. H. MacMillan*, Cambridge University, Cambridge, England (Paper No. 56—SA–17)

On the Dynamics of Pneumatic Transmission Lines, by *E. C. Grogan*, Radio Corporation of America, and *C. P. Rohmann*, Minneapolis-Honeywell Regulator Co. (Paper No. 56—SA–1)

Analysis and Design of a Servomotor Operating on High-Pressure Compressed Gas, by *Gerhard Reethof*, Vickers, Inc. (Paper No. 56—SA–20)

Registration Schedule

Sunday, June 17, 2:00 p.m. to 5:00 p.m.

Monday, June 18, 8:00 a.m. to 8:00 p.m.

Tuesday, June 19, 8:00 a.m. to 3:00 p.m.

Wednesday, June 20, 8:00 a.m. to 3:00 p.m.

Thursday, June 21, 8:00 a.m. to 12:00 noon.

Inspection Trips

2:00 p.m. The Cleveland Electric Illuminating Co.

2:00 p.m. Ford Motor Company's Cleveland Engine Plants.

INSPECTION TRIPS

Tuesday, June 19

10:00 a.m.

National Malleable & Steel Castings Company

Established in 1868, National Malleable operates three malleable foundries and four steel foundries. The major portion of its product is related to transportation. Most of the malleable castings are delivered "in the rough" to auto and truck manufacturers. Railroad castings include freight-car trucks, couplers, draft gears (shock absorbers), and yokes. Marine equipment consists mainly of cast-steel anchor chains, in wire diameter of 1 in. to 5 in.

In addition to the foundry operation, there is also located on this same property, a Technical Center. This is a complete engineering facility. Research, development, laboratory, and field testing of the company's products are conducted by a technical staff of approximately 90 persons.

2:00 p.m.

Ford Motor Company's Cleveland Engine Plants

Ford Motor Company's Cleveland engine plants are a striking example of the development of automation as a production technique in the automotive industry. Cleveland Engine Plant No. 1 was the first such factory in the industry to use the new technique in making automobile engines. It began operation four years ago, producing engines first for Fords and later for Mercurys.

Tours through these engine plants will provide an opportunity to see the ideals of automation in action—long clean production lines, along which intricate parts flow smoothly and evenly, just as fast as modern machine tools can handle them. Tours are organized to provide a firsthand view of the complete processing operation—from the cast block to the finished engine assembly running on a test block. For those who cannot make the trip on Tuesday, the trip will be made available on Thursday.

2:00 p.m.

Republic Steel Corporation

Republic Steel's 98-in. strip mill is one of the widest continuous hot-strip mills in the world. See 8-in. thick, 15-ton slabs heated to 23,000 deg in heating furnaces. From the furnaces, the slabs pass through a series of rollings which may reduce them to strip steel about $^1/_{10}$-in. thick and a quarter of a mile long. See the huge cold mills and temper mill in operation and watch how the finished steel is handled from the shipping floor. The trip will last about an hour and a quarter.

And

U. S. Air Force Heavy Press Plant, Cleveland, Ohio, Operated by Aluminum Company of America

The Air Force Heavy Press Plant was dedicated in May, 1955, and cost over $40 million. The buildings cover 12 acres and contain two of the largest hydraulic presses in the world with forging capacities of 50,000 and 35,000 tons. Both presses have a maximum die area 22 ft long × 8 ft wide. The plant contains complete supporting equipment including large die-sinking machines, straightening and trimming presses, scalping and sawing machines, heat-treat furnaces, ultrasonic and black-light inspection facilities.

2:00 p.m.

The Warner & Swasey Company

For 75 years Warner & Swasey has produced precision-machine tools. Here one will see turret lathes and automatic lathes being built by the latest production methods. Research in metal removal is carried on. Quality-control methods and techniques have been tailored to the manufacture of small and medium-quantity parts.

Machinery for the textile industry—notably the Warner & Swasey-Sulzer Weaving Machine and the pin drafter for yarn manufacture—will be shown in operation. In addition, the Pacific converter, for blending natural and synthetic fibers for yarns, will be on display, as will the Whirlwind Twister Winder, which processes yarns and cords of all fibers.

The Probograph, produced by the Warner & Swasey Research Corporation, will be shown

measuring and recording surface irregularities on turbine blades for jet engines.

The Gradall, the construction industry's most precise multipurpose machine, is completely hydraulic. Equipped with remote control, this unit will be operated and driven by one man. This demonstration will emphasize the high level of precision performance built into this piece of heavy equipment.

2:00 p.m.

The Standard Oil Company (Ohio) No. 1 Refinery

This particular refinery is the only refinery in the world with a continuous history of operation extending back to 1870, when on this site was established the first refinery of the Standard Oil Company.

Here will be seen how crude oil, the basic raw material, is separated into various higher and lower boiling parts which are then subjected to different types of treatment to manufacture the desired products.

This refinery has kept pace with the advances and development in the industry. Process units and mechanical shops will be seen.

Wednesday June 20

2:00 p.m.

NACA Lewis Laboratory

The NACA Lewis Flight Propulsion Laboratory is one of the nation's foremost research centers in the field of aircraft-propulsion systems.

In the tour of this laboratory, visitors will be shown one of the supersonic wind tunnels for propulsion research and its associated equipment. Altitude chambers capable of testing the largest turbojets as well as ramjets over a range of simulated-flight Mach numbers and altitudes will be inspected. The Rocket Laboratory, and typical compressor, turbine, combustion, and engine-materials test facilities are included in the tour.

Thursday, June 21

2:00 p.m.

The Cleveland Electric Illuminating Company

The Eastlake power plant of the Cleveland Electric Illuminating Company is located 20 miles east of downtown Cleveland, on the south shore of Lake Erie at the mouth of the Chagrin River. It is the company's newest power producer and ranks among the most efficient steam-generating stations in the country. Three 140,000-kw turbogenerators are now in use; a fourth unit of 240,000-kw capacity was recently put into service. Ranch type in style, the plant is modern in every detail, inside and out, incorporating the most up-to-date machines, control devices, and associated equipment. Its planned ultimate capacity of more than 1,000,000-kw will cost in excess of $125 million.

2:00 p.m.

Ford Motor Company's Cleveland Engine Plants

For details see same trip scheduled on Tuesday, June 19, 2:00 p.m.

WOMEN'S PROGRAM

SUNDAY, JUNE 17

2:00 p.m. Registration

4:00 p.m. Social Hour for all ASME men and women

6:30 p.m. Musicarnival—"The King and I" America's most luxurious tent theatre, where professional Broadway casts present the best in musical comedies and light operas in "theatre-in-the-round." Following the performance, ASME members and guests will meet members of the cast for an over-the-coffee-cup chat. Transportation will be arranged from Hotel Statler to Musicarnival and return.

MONDAY, JUNE 18

8:00 a.m. Registration

11:00 a.m. Industrial Valley tour—boat trip down Cuyahoga River. See Cleveland's great industries along the waterfront. Boat will dock passengers at Jim's Steak House, famous waterfront restaurant. At 3:00 p.m. a bus will wait to take passengers to the Thompson Products Company Antique Auto and Aviation Museum. Display of old-time automobiles, historic aircraft, famous oil paintings, and a "Gay Nineties" Main Street.

12:15 p.m. President's Luncheon

TUESDAY, JUNE 19

8:00 a.m. Registration

12:00 noon Lunch at NACA cafeteria to be followed at 1:30 by conducted tour of Lewis Flight Propulsion Laboratory of National Advisory Committee for Aeronautics. Inspection of wind tunnel; research engine laboratory, and so on. This lab is one of four situated throughout the country, others being at Moffat Field, Calif.; Edwards Field, Calif.; and Langley Field, Va. All persons on tour must be certified citizens of the U. S. A.

5:45 p.m. ASME Baseball Night—Cleveland Indians versus Boston Red Sox. A delicious roast-beef buffet dinner will be set in the outfield of Cleveland's Municipal Stadium, home of the Cleveland Indians. Meet the ballplayers before game time. Transportation from Hotel Statler to and from the stadium will be arranged.

WEDNESDAY, JUNE 20

8:00 a.m. Registration

1:30 p.m. Visit observation room of Terminal Tower Building. Inspection of Univac installation of C&O Railway, Terminal Tower Building.

3:30 p.m. Tea in Greenbrier Room, famous "Executive Suite" of the Van Sweringen Brothers, and now executive offices of the Chesapeake and Ohio Railway Co.

7:00 p.m. Banquet

THURSDAY, JUNE 21

8:00 a.m. Registration

12:00 noon Luncheon at University Club followed at 1:30 p.m. by

Conducted tour of Cleveland Health Museum, the first museum of its kind in the country. Many fascinating exhibits and on-the-spot tests of your hearing, sight, lung capacity; hear-your-own voice, and the famous "Juno," transparent lady, life-sized glass model, whose internal organs light up in sequence, as she gives her own lecture.

Literature

Atomic Energy

THE Atomic Industrial Forum has published the Proceedings of a Forum meeting on "Commercial and International Developments in Atomic Energy." The meeting was held in Washington, D. C., in September, 1955.

The 598-page document contains papers and illustrative material on power, test, and research reactors; radiation and radioisotopes; reactor safety; business opportunities in atomic energy; marketing atomic products and services; fuels and source materials; atomic activities outside the United States; and a review of Geneva Conference papers. A pictorial review of the Trade Fair is included. Publication price is $8.50.

Solar Energy

The Association for Applied Solar Energy has announced the publication of the proceedings of the World Symposium on Applied Solar Energy.

Published by Stanford Research Institute for the Association, the proceedings is considered a major publication in the solar-energy field. Running 300 pages, it contains 30 papers by internationally recognized authorities on solar energy.

Subjects include solar water heaters, solar collector design, solar energy conversion, and algal culture studies.

An opening seven-page section contains pictorial high lights of symposium sessions and of the Solar Engineering Exhibit, held in conjunction with the symposium.

Final section of the proceedings is a summary of the concluding session, a round-table discussion, which dealt with "The Future of Applied Solar Energy."

Price is $5, postpaid, from the Association, 204 Heard Building, Phoenix, Ariz.

ASME Applied Mechanics Conference to Be Held in Urbana, Ill., June 14–16

THE Conference of the Applied Mechanics Division of The American Society of Mechanical Engineers will be held at the University of Illinois, Urbana, Ill., June 14–16, 1956.

For those of you who arrive early, there will be a social meeting in the General Lounge of the Illini Union Building, June 13, 7:00 to 10:00 p.m. There will be a cocktail-dinner party in the Mural Dining Room of the Hotel Tilden Hall, Champaign, Ill., on Thursday, June 14, at 6:30 p.m. And, on the final day of the Conference, at the Illini Union Building, there will be a banquet of the Applied Mechanics Division.

There will be a women's program to provide entertainment for the period of the Conference, including a Luncheon and Bridge Party to be held at the Allerton House, Allerton Park, at 1:00 p.m., June 14. Transportation will be provided.

The tentative program follows:

THURSDAY, JUNE 14

10:00 a.m. **Room 100, Gregory Hall**

Session (IA)

Chairman: *R. E. Peterson*, manager, mechanics department, Westinghouse Research Laboratories, East Pittsburgh, Pa.

Vice-Chairman: *D. D. Kilner*, associate professor of mechanical engineering, The Technological Institute, Northwestern University

A New Method of Analyzing Stresses and Strains in Work-Hardening Plastic Solids,[1] by *William Prager*, Brown University

On the Carrying Capacity of Redundant Structures, by *E. F. Masur*, University of Michigan, and *K. P. Milbradt*, Illinois Institute of Technology (Paper No. 56—APM–8)

The Time-Dependent Tangent Modulus Applied to Column Creep Buckling, by *R. L. Carlson*, Battelle Memorial Institute (Paper No. 56—APM–13)

An Elastoplastic Thermal-Stress Analysis of a Free Plate, by *J. H. Weiner*, Columbia University (Paper No. 56—APM–6)

The Propagation of Fatigue Cracks,[2] by *A. K.*

[1] Paper not available—see box on page 476.
[2] Presented by title only.

Head, scientific officer, Department of Supply, Melbourne, Australia (Paper No. 56—APM–15)

Three Neutral Loading Tests,[2] by *S. S. Gill*, College of Technology, University of Manchester, Manchester, England (Paper No. 56—APM–18)

2:00 p.m. **Room 100, Gregory Hall**

Session (IB)

Chairman: *E. Volterra*, professor of mechanics, Rensselaer Polytechnic Institute.

Vice-Chairman: *M. C. Steele*, associate professor of theoretical and applied mechanics, College of Engineering, University of Illinois

A Method for Determining the Flexural Effects of Statically Loaded Beams on Multiple Elastic Supports, by *R. A. DiTaranto*, Engineering Products Division, Radio Corporation of America, Camden, N. J. (Paper No. 56—APM–24)

The Effect of Shear on the Plastic Bending of Beams, by *D. C. Drucker*, Brown University (Paper No. 56—APM–28)

Impulsive Loading of Elastic-Plastic Beams, by *J. A. Seiler, B. A. Cotter*, and *P. S. Symonds*, Brown University (Paper No. 56—APM–17)

Impact With Finite Acceleration Time of Elastic and Elastic-Plastic Beams, by *R. C. Alverson*, Division of Engineering, Brown University (Paper No. 56—APM–14)

The Mathematical Analysis of Bow Girders of Any Shape,[2] by *M. M. Abbassi*, Faculty of Engineering, Alexandria University, Alexandria, Egypt (Paper No. 56—APM–23)

Thermal Stresses in Infinite Elastic Disks,[2] by *B. Sharma*, Birla College, Pilana, Rajasthan, India (Paper No. 56—APM–19)

FRIDAY, JUNE 15

9:30 a.m. **Room 100, Gregory Hall**

Session (IIA)

Chairman: *E. Reissner*, professor of mathematics, Massachusetts Institute of Technology

Vice-Chairman: *Yi-Yuan Yu*, associate professor of mechanical engineering, L. C. Smith College of Engineering, Syracuse University

Bending of a Uniformly Loaded Semicircular Plate Simply Supported Around the Curved Edge and Free Along the Diameter, by *D. Muster*, General Engineering Laboratory, General Electric Co., Schenectady, N. Y., and *M. A. Sadowsky*, Rensselaer Polytechnic Institute (Paper No. 56—APM–7)

A Study of Orthogonally Stiffened Plates, by *W. H. Hoppmann, 2nd*, The Johns Hopkins University, *N. J. Huffington, Jr.*, Virginia Polytechnic Institute, and *L. S. Magness*, The Johns Hopkins University (Paper No. 56—APM–11)

Stress Solutions for an Infinite Plate With Triangular Inlay, by *R. M. Evan-Iwanowski*, L. C. Smith College of Engineering, Syracuse University (Paper No. 56—APM–4)

On the Stresses and Deflections of Rectangular Beams, by *B. A. Boley* and *Irwin S. Tolins*, Institute of Air Flight Structures, Columbia University (Paper No. 56—APM–1)

On the Transmission of a Concentrated Load Into the Interior of an Elastic Body, by *G. L. Neidhardt*, American Steel Foundries, Chicago, Ill., and *E. Sternberg*, Illinois Institute of Technology[1]

On the Stresses in a Strip Under Tension and Containing Two Equal Circular Holes,[2] by *A. Atsumi*, Tôhoku University, Sendai, Japan (Paper No. 56—APM–12)

9:30 a.m. **Room 112, Gregory Hall**

Symposium: Shock and Vibration

Symposium (1)

Chairman: *C. E. Crede*, Barry Controls, Inc., Watertown, Mass.

Vice-Chairman: *D. F. Muster*, General Electric Co., Schenectady, N. Y.

The Evaluation of Mounts Isolating Nonrigid Machines From Nonrigid Foundations,[1] by *A. O. Sykes*, David Taylor Model Basin, Navy Department, Washington, D. C.

Experimental Studies of the Effect of Foundation Resilience on Vibration Isolation,[1] by *R. N. Hamme*, University of Michigan

Effect of Material and Slip Damping on Resonance Behavior,[1] by *B. J. Lazan* and *L. E. Goodman*, University of Minnesota

Shock and Vibration Environments,[1] by *C. T. Morrow*, The Ramo-Wooldridge Corp., Los Angeles, Calif.

Mechanical Design for Random Vibration and Shock,[1] by *R. M. Mains*, General Electric Co., Schenectady, N. Y.

2:00 p.m. **Room 100, Gregory Hall**

Session (IIB)

Chairman: *R. S. Hartenberg*, associate professor of engineering mechanics, The Technological Institute, Northwestern University

Vice-Chairman: *A. P. Boresi*, assistant professor of theoretical and applied mechanics, College of Engineering, University of Illinois

A Study of Buckling Strength of Thin Cylinders With and Without Circumferential Stiffeners Under External Pressure,[1] by *L. H. Donnell*, Illinois Institute of Technology

The Effects of Boundary Conditions and Initial Out-of-Roundness on the Strength of Thin-Walled Cylinders Subject to External Hydrostatic Pressure, by *G. D. Gallelly*, head, Plates and Shells Section, and *R. Bart*, structural research engineer, David Taylor Model Basin, Washington, D. C. (Paper No. 56—APM–9)

Three-Dimensional and Shell-Theory Analysis of Axially Symmetric Motions of Cylinders, by *G. Herrmann*, Institute of Flight Structures, and *I. Mirsky*, Columbia University, New York, N. Y. (Paper No. 56—APM–32)

Minimum Weight Design of Cylindrical Shells, by *Walter Freiberger*, Brown University (Paper No. 56—APM–33)

Buckling of Rectangular Plates Uniformly Compressed in Two Perpendicular Directions With One Free Edge and Opposite Edge Elastically Restrained;[2] by *P. Shuleshko*, lecturer in civil engineering, The New South Wales University of Technology, Sydney, Australia (Paper No. 56—APM–20)

2:00 p.m. **Room 112, Gregory Hall**

Symposium: Shock and Vibration

Symposium (2)

Chairman: *J. M. Frankland*, Columbia University

Vice-Chairman: *P. F. Chenea*, Purdue University

The Influence of Electrical and Motional Impedance on the Control and Performance of Vibration Machines,[1] by *Karl Unholtz*, MB Manufacturing Co., New Haven, Conn.

Shock-Testing Machines and Procedures,[1] by *D. C. Kennard*, Wright Air Development Center, Dayton, Ohio, and *Irwin Vigness*, Naval Research Laboratory, Washington, D. C.

Damaging Potential of Shock and Vibration,[1] by *R. E. Blake, R. O. Belsheim*, and *J. P. Walsh*, Naval Research Laboratory, Washington, D. C.

High-Speed Computing Methods for Shock and Vibration Problems,[1] by *D. E. Hudson* and *H. Lurie*, California Institute of Technology

Application of Direct Electrical Analogy Principles to Shock and Vibration Analysis,[1] by *G. D. McCann*, California Institute of Technology

SATURDAY, JUNE 16

9:30 a.m. **Room 100, Gregory Hall**

Session (IIIA)

Chairman: *G. Horvay*, Metallurgy and Ceramics Research Department, General Electric Co., Schenectady, N. Y.

Vice-Chairman: *P. H. McDonald, Jr.*, research associate professor of mechanical engineering, North Carolina State College

Wave Propagation in an Elastic Rod Exhibiting Internal Coulomb Friction, Considered as a Model for a Ring Spring, by *E. H. Lee* and *A. J. Wang*, Brown University (Paper No. 56—APM–5)

On the Role of Extension in the Flexural Vibrations of Rings, by *L. L. Philipson*, Radome Design Section, Microwave Laboratory, Hughes Research Laboratories, Culver City, Calif. (Paper No. 56—APM–2)

Effect of Spring Mass on Contact Accelerometer Responses, by *T. H. Lin*, professor of aeronautical engineering, University of Detroit, and visiting professor of engineering, University of California (Paper No. 56—APM–3)

On the Theory of the Acceleration Damper, by *Carl Grubin*, Douglas Aircraft Co., Inc., Santa Monica, Calif. (Paper No. 56—APM–10)

Influence of Large Amplitudes on Free Flexural Vibrations of Rectangular Elastic Plates,[2] by *George Herrmann* and *Hu-Nan Chu*, Columbia University (Paper No. 56—APM–27)

The Modes of Vibration of a Certain System Having a Number of Equal Frequencies,[2] by *D. C. Johnson*, University lecturer in engineering and Fellow of Trinity Hall, and *R. E. D. Bishop*, University lecturer in engineering and Fellow of Pembroke College, Engineering Laboratory, Cambridge University, Cambridge, England (Paper No. 56—APM–16)

2:00 p.m. **Room 100, Gregory Hall**

Session (IIIB)

Chairman: *P. F. Chenea*, chairman, Division of Engineering Sciences, Purdue University

Vice-Chairman: *B. T. Chao*, professor of mechanical engineering, College of Engineering, University of Illinois

The Tapered-Land Thrust Bearing, by *C. F. Kettleborough*, senior lecturer in mechanical engineering, University of Melbourne, Victoria, Australia. Presently with Westinghouse Research Laboratories, East Pittsburgh, Pa. (Paper No. 56—APM–21)

The Sector-Shaped Pad, by *C. F. Kettleborough*, senior lecturer in mechanical engineering, University of Melbourne, Victoria, Australia. Presently with Westinghouse Research Laboratories, East Pittsburgh, Pa. (Paper No. 56—APM–22)

The Boundary Layer Inside a Conical Surface Due to Swirl, by *Helmut E. Weber*, Shell Development Co., Emeryville, Calif. (Paper No. 56—APM–31)

On the Torsional Oscillations of a Solid Sphere in a Viscous Fluid, by *G. F. Carrier* and *R. C. DiPrima*, Harvard University (Paper No. 56—APM–29)

A Theory for Base Pressures in Transonic and Supersonic Flow, by *H. H. Korst*, University of Illinois (Paper No. 56—APM–30)

On the Determination of the Viscoelastic Model for Stress Analysis of Plastics,[2] by *D. R. Bland*, Imperial Chemical Industries Research Fellow, King's College, London, England, and *E. H. Lee*, Brown University (Paper No. 56—APM–26)

[1] Paper not available—see box on page 476.
[2] Presented by title only.

World Power Conference, Vienna, June 17–23

The Fifth World Power Conference to be held in Vienna, Austria, June 17–23, 1956, will have for its theme "World Energy Resources in the Light of Recent Technical and Economic Developments."

The technical program will be presented in 18 sessions. Several social events, sightseeing trips, and inspection trips, including engineering works and industries in Austria and frontier areas of Germany, Italy, and Yugoslavia round out the official program. An excellent many-faceted program has been arranged for the women accompanying the conferees.

For more detailed information on this conference write to the United States National Committee World Power Conference, 29 West 39th St., New York 18, N. Y.

ASME Membership

as of March 30, 1956

Honorary Members	72
Fellows	401
Members	14,676
Affiliates	297
Associate Members (33 and over)	4,313
Associate Members (30–32)	6,198
Associate Members (to age of 29)	13,875
Total	39,832

F. X. Gilg, Chairman of the United States Delegation to ISO TC/11 Conference on an international code for safe construction and stationary boilers, in Madrid, February 4–24, addresses 130 delegates from 16 countries

On a trip to the Instituto Nacional de Industria during the ISO TC/11 Conference are shown, *left to right,* F. X. Gilg; J. D. Wilding; Jose Silavent, director of INI; and Aureo Fernandez Avila

High light of the ISO TC/11 Conference was a party at the American Embassy on February 20. Ambassador and Mrs. John D. Lodge, *third and fourth from left,* receive at reception.

The delegates to ISO TC/11 Conference, held in the Instituto Nacional de Racionalizacion del Trabajo in Madrid, attend a party in their honor at the Madrid City Hall

ISO TC/11 Unification of Boiler Codes Holds Meeting in Madrid, Spain

The second plenary session of International Standardization Organization Technical Committee No. 11 on Unification of Boiler Codes, took place in Madrid, Spain, at the Instituto Nacional de Racionalizacion del Trabajo, February 6 to 24. The Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers holds the Secretariat of this ISO technical committee acting for the American Standards Association. The object was to bring existing boiler codes of various countries closer together so that boilers built in one country could be more readily accepted in other countries.

The three-week meeting was attended by 130 delegates from the following 16 countries: Austria, Belgium, Canada, Czechoslovakia, France, Germany, India, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom, USSR, and United States. Australia, Poland, and Union of South Africa were represented by proxy.

American Delegation

The American delegation consisted of the following members: F. X. Gilg, The Babcock & Wilcox Company; J. L. Menson, Combustion Engineering, Inc.; C. W. Wheatley, A. O. Smith Corporation; E. O. Bergman, C. F. Braun & Company; F. S. G. Williams, Taylor Forge & Pipe Works; E. C. Korten, Hartford Steam Boiler Inspection & Insurance Company; C. H. Jackman, United States Steel Corporation; J. G. Althouse, Lukens Steel Company; and J. D. Wilding, secretary of the Boiler and Pressure Vessel Committee, ASME.

Mr. Gilg was elected chairman to conduct the meetings and Mr. Menson became leader of the American delegation.

Draft Proposal, which was prepared in New York in July, 1955, printed and circulated by ASME in October, 1955, was used as a basis for discussions. During the meetings, seven working groups were established to narrow the differences of opinion which were then accepted by a majority vote at the meetings.

From the standpoint of the Secretariat, the meetings in Madrid were successful in that a Draft Proposal was approved by a substantial majority of the delegations attending the meetings. However, some of the sections were not acceptable to the American delegation because of some fundamental differences in code-writing philosophy which will have to be worked out in later discussions.

The International Organization for Standardization (ISO) established Technical Committee Number 11—Unification of Boiler Codes in 1951 to work on this project, assigning the secretariat through the American Standards Association to the Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers. Previous meetings were held in Paris in 1953 and 1954, London, Dusseldorf, and The Hague in 1955.

After three days of meetings the Plenary Sessions were recessed to permit seven Working Groups to study various phases of boiler design and construction, such as materials, designs, welding, fabrication, fittings and mountings, testing and inspection, certification and

stamping, and scope. These Working Groups produced recommendations which were presented to the Plenary Sessions during the final week of the meetings. Approved recommendations will be incorporated in a Draft Recommendation which will be circulated to all participating nations for ballot approval.

The International Organization for Standardization is composed of the national standards organization of 37 countries of the world. It has some 80 technical committees in existence studying the standardization of various items such as boilers, textiles, rubber, plastics, steel, welding, and other subjects.

Social Events

There were several receptions arranged for the entire delegation but the high light of the social events was the reception on February 20 at U. S. Embassy, a spacious mansion which was formerly a royal palace. This event was arranged by ASME. Ambassador and Mrs. John Lodge, as well as his brother, Henry Cabot Lodge, U. S. Ambassador to the United Nations, were there to receive, with their staff including military aides. Refreshments were served while a native string quartet wandered about playing Spanish folk tunes.

On Wednesday, February 22, the host, The Instituto Nacional de Racionalizacion del Trabajo, gave a reception and banquet for the entire group at the Castellana Hilton Hotel. Mr. Gilg acted as toastmaster and called on the leaders of the delegations to say a few words to the assembled guests. It was a fitting close to the festivities as the meetings were terminated at noon the next day.

Improving Management With and for Engineers—Theme of ASME Engineering Management Conference

The fourth annual Engineering Management Conference of the Management Division of The American Society of Mechanical Engineers was held March 14 and 15, at the Hotel Statler, St. Louis, Mo.

The program was the result of joint efforts by the Management Division and the St. Louis Section of ASME in co-operation with the Management Committee and St. Louis Section of the American Institute of Electrical Engineers. The conference paid tribute to Frederick Winslow Taylor, the "Father of Scientific Management," on the one-hundredth anniversary of his birth, March 20, 1856. Dr. L. M. Gilbreth, Hon. Mem. ASME, was principal speaker at this commemorative luncheon.

The technical program was carried out in four sessions; namely, Effective use of engineering skill, Development of the engineer as a manager, The engineer makes his contribution to management, and Industry should share in the training of the engineer.

In a discussion of the effective use of engineers in design, B. C. Boulton, assistant to vice-president, engineering, McDonnell Aircraft Corporation, St. Louis, Mo., said three factors determine the effective use of engineers: Adequate training at all levels; challenging job assignments matched to the man's capabilities; and maintenance of a climate conductive to professional growth and development.

"The shortage of qualified research engineers in the United States," said H. R. Kemmerer, assistant manager, manufacturing-research department, Shell Oil Company, New York, N. Y., "demands that every effort be made to use the time and special skills of the research engineer with maximum efficiency."

T. R. Thoren, staff director engineering, research, and development, Thompson Products, Inc., Cleveland, Ohio, revealed that the time interval between the discovery of a new scientific principle and the appearance of articles of commerce incorporating the new principle, continues to shorten. Engineers have learned to their fascination that many tools of the scientific laboratory are a necessity in today's engineering-development work.

"The Art of Applying Science" was the topic of a paper presented by L. E. Lattin, vice-president, Personnel, Southwestern Bell Telephone Company, St. Louis, Mo. He discussed the practical problems involving the sources and utilization of technological training in industry and the relationship of humanistic training to business and to economic and social trends.

Availability List for 1956 ASME Engineering Management Conference Papers

The papers in this list are available in separate copy form until Jan. 1, 1957. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
56—MGT-1	Applying Linear Programming to Inventory Planning in a Seasonal Market—A Case Study, by D. W. Moffett
56—MGT-2	Practical Equipment - Replacement Economics, by P. A. Schneuble, Jr.
56—MGT-3	The Art of Applying Science, by L. E. Lattin

ESL Plans French Scientific and Technical Book Exhibit

Some 250 French scientific and technical books will be exhibited at the Engineering Societies Library, 29 West 39th Street, New York, N. Y. during June, 1956. Here engineers, educators, scientists, and researchers will be able to browse through selected books made available by the Cultural Division of the French Embassy, New York, through the co-operation of the leading publishing firms in France.

There will be books in the fields of civil, chemical, electrical, mechanical, and mining and metallurgical engineering; industrial physics; and mathematics, physics, and the earth sciences. One of the purposes of the exhibit is to keep American engineers, engineering educators, and researchers informed of the advances made by their French colleagues.

The exhibit will be in the Reading Room of the Engineering Societies Library which, during June, will be open Mondays through Saturdays, 10:00 a.m. to 5:00 p.m.

ASME Coming Events

May 8–11
ASME Metals Engineering-AWS Conference, Hotel Statler, Buffalo, N. Y.
(Final date for submitting papers was Dec. 31, 1955)

May 23–25
ASME-EIC Meeting, Mount Royal Hotel, Montreal, Que., Can.
(Final date for submitting papers was Dec. 31, 1955)

June 11–13
ASME Applied Mechanics Western Division Conference, California Institute of Technology, Pasadena, Calif.
(Papers being accepted until program is filled)

June 14–16
ASME Applied Mechanics Division Conference, University of Illinois, Urbana, Ill.
(Final date for submitting papers was Feb. 1, 1956)

June 17–21
ASME Semi-Annual Meeting, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers was Feb. 1, 1956)

June 19–22
ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting held jointly with the National Board of Boiler and Pressure Vessel Inspectors, Windsor Hotel, Montreal, Que., Can.

Sept. 10–12
ASME Fall Meeting, Cosmopolitan Hotel, Denver, Colo.
(Final date for submitting papers was May 1, 1956)

Sept. 17–21
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Coliseum, New York, N. Y.
(Final date for submitting papers was May 1, 1956)

Sept. 23–26
ASME Petroleum-Mechanical Engineering Conference, Conrad Hilton Hotel, Dallas, Texas
(Final date for submitting papers was May 1, 1956)

Oct. 8–10
ASME-ASLE Third Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers—June 1, 1956)

Oct. 24–25
ASME-AIME Joint Fuels Conference, Sheraton Park Hotel, Washington, D. C.
(Final date for submitting papers—June 1, 1956)

Nov. 25–30
ASME Annual Meeting, Hotel Statler, New York, N. Y.
(Final date for submitting papers—July 1, 1956)
(For Meetings of Other Societies, see page 493)

ASME President J. W. Barker, *center,* discusses Aviation Conference program with Brig. Gen. R. L. Winn, *left,* USAF, Director of Transportation and Services, Air Materiel Command, Wright-Patterson AFB, Ohio, and Brig. Gen. J. W. Andrew, *right,* USAF, Commander, 27th Air Division. The conference was held March 14–16 at the Hotel Statler, Los Angeles, Calif.

ASME Aviation Conference, Los Angeles, Host to Thousands of Engineers

THE annual conference of the Aviation Division of The American Society of Mechanical Engineers held March 14–16 in the Hotel Statler, Los Angeles, Calif., was one of the most successful West Coast divisional meetings ever conducted by the Society.

More than 2000 engineers attended the three-day meeting which featured 50 papers presented at 20 technical sessions. The conference was cosponsored by the ASME Instruments and Regulators Division; The American Rocket Society, an affiliate of ASME; and the Institute of the Aeronautical Sciences, in co-operation with the Southern California Section, ASME.

The large attendance, the high quality of the papers, and the unprecedented demand for reprints confirms the growing position of the Southern California area as the nation's foremost center of the aircraft activity.

Technical Events

The technical papers developed two major themes: "Thorns in the Thermal Thicket" and "Air Cargo and Air Logistics—Today and Tomorrow." The part of the program devoted to identification of thorns in the thermal thicket included papers on structures and materials problems, human problems, accessories, propulsion, and instrumentation problems. The air-cargo and air-logistics program covered a market-analysis panel and discussion of civil air-cargo matters, a research forecast and military air-cargo applications. A field inspection of the Douglas C-133 cargo transport served as a fitting climax.

A most significant session was held on the evening of March 14, devoted to "The Advance in the State of the Art," and featured R. C. Sebold, vice-president of engineering at Convair, who spoke on "The Challenge of Progress" and G. A. Schairer, chief of the technical staff at the Boeing Airplane Company, whose topic was "High-Speed Problems of Large Airplanes."

Control Air Traffic

Delivering the principal address at the Opening Day luncheon, March 14, Brig. Gen. James W. Andrew, Commander, 27th Air Division, Norton AFB, Calif., described automatic air-space controls as "an absolute necessity" for air-traffic control.

"With airplanes going faster and the air becoming more and more congested, we must look to automation for solutions to the problem," he said. "Airplanes become dangerous projectiles as soon as they leave the ground and electronic controls are the only way of safeguarding both the airplane and residents of the areas surrounding air bases." Brig. Gen. R. L. Winn, Director of Transportation at Wright-Patterson AFB, Ohio, was a special guest at the luncheon.

Develop Arts of Peace

At the Aviation banquet, March 15, C. C. Furnas, Mem. ASME, Assistant Secretary of Defense for Research and Development, called on Americans to demonstrate their ability in the arts of peace as well as of war.

"Making friends through the media of industry and technology is old and familiar ground to us," he said. "We should devote as much energy and time to improving our international human relations as we do to technical matters. The Soviet Union is beginning to do this, and we must not lag behind."

At a press conference prior to the banquet, Dr. Furnas disclosed that he and Frank Newbury, Assistant Secretary of Defense for Application Engineering, are locked in a struggle for development authority. Secretary Wilson will eventually resolve the jurisdictional problem, Dr. Furnas said, intimating that he would resign if his viewpoint is not accepted.

Test Pilots Discuss Their Problems

Leading test pilots from major aircraft companies called for greater understanding of the pilot's problems at a panel discussion that highlighted the March 15 luncheon. Moderated by Major Stuart Childs, chief of fighter test, Edwards AFB, the panel heard discussions on "What I Want From the Engineer" from Bert Foulds, chief test pilot, Douglas Aircraft Company; Herman "Fish" Salmon, chief experimental pilot, Lockheed Aircraft Corporation; Lewis Nelson, chief experimental test pilot, Northrop Aircraft, Inc.; Tex Johnston, chief pilot, Boeing Airplane Co.; Dick Johnson, chief test pilot, Convair Division of General Dynamics Corp.; and Joseph Walker, test pilot, National Advisory Committee for Aeronautics.

Highlighting the technical papers was a disclosure that temperature extremes ranging from 400 deg to below zero and meteoric dust are the two main dangers the United States earth satellite will face in circling the globe next year. F. R. Furth, Farnsworth Electronics Company, said the three-stage rocket which will carry the satellite vehicle to its orbital path around the earth will weigh between 20,000 and 25,000 lb.

At the conclusion of the conference on March 16, the aviation engineers toured the C-133 cargo line at Douglas Aircraft Company's Long Beach Division, the UCLA Thermal-Biotechnology Laboratory, and Marquardt Aircraft Company.

Availability List for 1956 ASME Aviation Conference Papers

THE papers in this list are available in separate copy form until Jan. 1, 1957. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
56—AV-1	Development and Evaluation of an Icing Indicator, by M. P. MOYLE, S. W. CHURCHILL, MYRON TRIBUS, and H. W. STUBBS
56—AV-2	Human Problems in the Development of the F-102 Cockpit, by W. H. REINEKING
56—AV-3	Descriptions and Prediction of Human Response to Aircraft Thermal Environments, by C. L. TAYLOR

56—AV-4 Ventilated Clothing as a Protection Against Heat Exposure, by P. Webb

56—AV-5 High-Temperature Aircraft Hydraulics, by G. R. Keller

56—AV-6 Drag Turbine Performance, by O. E. Balje

56—AV-7 Modernization of Airborne Electronic Equipment by the Use of Transistors, by P. D. Davis, Jr., and J. W. Lacy

56—AV-8 Aluminum Alloys for Elevated-Temperature Applications, by E. H. Dix, Jr.

56—AV-9 Some Structural Penalties Associated With Thermal Flight, by J. W. Mar and L. A. Schmit

56—AV-10 The Application of a New Structural Index to Compare Titanium Alloys With Other Materials in Airframe Structures, by L. R. Jackson and S. A. Gordon

56—AV-11 Optimum Stresses of Structural Elements at Elevated Temperatures, by A. Schnitt, M. A. Brull, and H. S. Wolko

56—AV-12 Thermostructural Efficiencies of Compression Elements and Materials, by George Gerard

56—AV-13 Weight-Efficiency Analysis of Thin-Wing Construction, by R. A. Anderson

56—AV-14 Design Criteria for Heated Aircraft Structures, by Robert Goldin

56—AV-15 Aircraft Structural Testing Techniques at Elevated Temperatures, by R. B. Baird and R. C. Brouns

56—AV-16 Some NACA Research on the Effect of Transient Heating on Aircraft Structures, by J. E. Duberg

56—AV-17 Utilization of Solar Furnaces in High-Temperature Research, by Pol Duwez

56—AV-18 Discussion on Safety-Factor Requirements for Supersonic Aircraft Structures, by G. M. Goldman

56—AV-19 The Challenge of Progress, by R. C. Sebold

56—AV-20 Mass Flowmeter for In-Flight Refueling, by C. F. Taylor

56—AV-21 The Technical Appraisal of the Performance of OS-45 and/or OS-45-1 High-Temperature Hydraulic Fluids, by H. S. Litzsinger and R. E. Hatton

56—AV-22 Oronite High-Temperature Hydraulic Fluids 8200 and 8515, by N. W. Furby, R. L. Peeler, and R. I. Stirton

56—AV-23 A Comparison of Hydraulic and Pneumatic Accessory Power Generation, by E. I. Brown

56—AV-24 High-Speed Problems of Large Airplanes, by G. S. Schairer

56—AV-25 High-Temperature Problems of Airborne Electrical Equipment, by L. J. Lyons

56—AV-26 The Large Water-Based Transport and Its Military Uses, by Guy Mallery, Jr.

56—AV-28 Recent Advances in Miniature Instrument-Bearing Technology, by O. M. Bergethon

56—AV-29 Controlled Gyro Tumbling by Means of a High-Angle Gimbal Stop, by Louis Curdo

56—AV-30 Measuring Ramjet Tail-Pipe Temperatures, by P. J. Valentine and E. P. French

Conference on Lubrication and Wear to Be Held in London, 1957

The Council of The Institution of Mechanical Engineers are arranging a Conference on Lubrication and Wear to be held in London, England, Oct. 1–3, 1957. It will be international in scope, as papers are being sought from the United States, Canada, and most European countries as well as the United Kingdom. The American Society of Mechanical Engineers has been asked to co-operate in this effort by obtaining suitable papers from American and Canadian authors.

It is intended that the published proceedings of the Conference will constitute a useful reference work covering the whole field of lubrication and wear. Hence it is planned to have papers that collate and summarize well-established aspects of the subject and, where possible, enlarge on them, and other papers devoted to topics that are rapidly developing.

The preliminary program includes sessions devoted to the following subjects:

1 Limitations of the theoretical treatment of fluid-film lubrication and the relationship with experimental results.

2 Evaluation of present knowledge in regard to fluctuating loads and bearing oscillations.

3 Thin films and elastohydrodynamic lubrication.

4 Physics and physical chemistry of solid friction and boundary lubrication.

5 Wear, including fretting corrosion, the running in of mechanisms, wear due to abrasion and foreign particles, influence of lubricants, scuffing, major surface changes, influence and nature of rubbing surfaces, technique of wear investigation.

6 Bearing metals and other bearing materials, lubrication of glands and seals, solid lubricants, and surface treatments.

7 Antifriction bearing and gear lubrication.

8 Additives for lubricants, fluids for metal cutting and forming.

9 Special problems in connection with atomic energy.

Authors are asked to submit first a brief synopsis, of 200 words, by Sept. 1, 1956, setting forth the proposed title and contents of their contribution. This should be sent to C. C. Moore, General Engineering Laboratory, General Electric Company, Schenectady, N. Y.; January 1, 1957, is the deadline date set for submitting completed papers.

It is expected that some of the papers by U. S. and Canadian authors will be selected for presentation at the ASLE-ASME Lubricating Conference, October, 1957, at Toronto, Ont., Can.

High-School Science Classes Aided by Local Professional Groups

The present shortage of scientists and engineers, and the even greater impending shortage, is a matter of national concern. This concern has filtered down much farther and at many points local groups are trying to do something about it. This is true in the Mid-Hudson area where three professional groups have pooled their efforts. These groups are the Mid-Hudson Section of the American Chemical Society, the Mid-Hudson Section of The American Society of Mechanical Engineers, and the Texaco Research Club. These organizations feel that once interest has been awakened in the high-school students, many of them who otherwise might never give a thought to a career in engineering or science would continue on to college and become top-notch in the field of their choice.

One reason for this lack of interest is apparently the student's lack of knowledge about what is involved in a career in engineering or science. A critical shortage of science teachers and lack of laboratory equipment also pose a problem at many schools.

These three organizations have worked out a program which is intended to help overcome some of the difficulties. Since there are specialists in many fields of science and engineering represented in the membership of these groups, assistance is available to the high-school science teacher and vocational-guidance counselor in a number of different ways. Some of these experts will meet with the guidance counselor or teacher and student to help in planning the student's science career. Others will meet with classes to discuss the opportunities and responsibilities of entering certain fields of engineering. Talks on various phases of the different sciences and a series of lecture demonstrations co-ordinated with the course of study are being given at some of the schools. Another group is prepared to help the student obtain information about scholarships at different colleges. Thus the members of these organizations are making available their experience and training and in many cases are demonstrating equipment which would not normally be available to the schools. All of this, it is hoped, will help to arouse in the student an interest in the sciences and a desire to continue his education at some college.

A representative from each of the three co-operating organizations has been named to a committee which will co-ordinate the efforts of the three groups. George B. Hatch of The Texas Company, is representing the American Chemical Society, Ambrose Kennedy of IBM, The American Society of Mechanical Engineers, and Harry C. Becker of The Texas Company, the Texaco Research Club.

F. L. Peterson, *right*, Mayor of Portland, Ore., presents key to the city to ASME President J. W. Barker, *left*, during the ASME Spring Meeting. Bryan T. McMinn, *center*, Vice-President, ASME Region VII, looks on.

ASME Spring Meeting Examines Pacific Northwest's Record in Power Generation and Lumber Production

Leaders in these fields of engineering spark program. Inspection trips show wise management of natural resources.

The 1956 Spring Meeting of The American Society of Mechanical Engineers was held at the Multnomah Hotel, Portland, Ore., March 18–21, 1956. With the giant hydroelectric installations of the Pacific Northwest and Oregon's record in timber conservation lumber production, it was appropriate that seven of the 18 technical sessions were devoted to these topics.

President's Luncheon

Joseph W. Barker, ASME President, addressing the large audience at the President's Luncheon, said the program for the meeting was planned that way because we wanted to learn about those industries at the source.

He said the information that is revealed at this meeting will become part of the permanent literature of technology. It will be distributed to the hundreds of people who will write to ASME for copies of the papers presented. It will be reported to the hundreds of thousands of persons who read America's technical magazines, the greatest storehouse of current technical data in the world. And some of what happens here will come to the attention of millions of newspaper readers across the land.

"This Meeting," Dr. Barker said, "is in the best tradition of ASME. One of the purposes set forth in our constitution is 'to promote the intercourse of engineers among themselves and with allied technologists.' Alexander Lyman Holley, who helped found this organization 75 years ago, listed three advantages to be obtained by the formation of an American Society of Mechanical Engineers. One of them was the 'collection and diffusion of definite and much-needed information by means of papers and discussion.'"

Aviation Conference

Commenting on the Society's 1956 Program, he said, "This year we are collecting and diffusing more information than ever before. I have just come from our Aviation Division Conference in Los Angeles. That was a history-making event. They discussed two broad subjects important to aviation there. One of them they called 'Thorns in the Thermal Thicket.' The participants at that meeting made a significant contribution toward solving one of aviation's greatest problems: What happens to machines and materials—and men—in supersonic flight?

"The other major topic at that meeting was 'Air Cargo and Air Logistics,' and we were privileged to hear a great deal of intelligent and informed data on what looks like the most revolutionary development today in the fields of civilian and military transportation.

Engineering-Management Conference

"At the same time, in St. Louis, Mo., ASME was holding its Fourth Annual Engineering Management Conference, the latest in a series that was begun in 1953 and that has attracted management leaders from all over the nation. Among the speakers at St. Louis was Albert C. Hall, of Bendix Aviation Corporation. He was one of three ASME members who recently made a tour of Russian factories and other installations, at the request of the State Department."

Instruments and Regulators Conference

"Next week, our Instruments and Regulators Division will hold a conference on the campus of Princeton University. A week after that I will be attending ASME's Oil and Gas Power Division Conference in New Orleans. That will be followed by our Machine Design Division Conference in Worcester, Mass., and our first Gas Turbine Power Division Conference, in Washington, D. C.

"That makes seven meetings within the space of a month. I am telling you about these other conferences because I would like you to see *this* meeting in the context of the many things ASME does. It is true that this meeting is meant to interest a wider section of the Society's membership, but it should be con-

T. W. Delzell, *right*, board chairman and chief executive officer, Portland General Electric Company, in a ceremony at the McLoughlin Monument, Oregon City, shown with Dr. Barker, commemorating one of the first long-distance transmissions of electricity in the U. S.

At Wood Industries session, *left to right,* are Norman E. Nelson, Stanley E. Corder, S. M. Batori, and C. D. Miller

sidered, even so, not as an entity of itself, but as another chapter—a most important chapter—in the growing book of technology.

"It is not strictly accurate to say that this meeting began this morning, or that it will end later in the week. The truth is that it is a continuation of man's eternal search for knowledge, and that its results will be felt for many years after we have packed away our gavels and moved out of this hotel."

Wood Industries

"What are we going to talk about this week? One of the major categories is represented by our Wood Industries Division, which will be 35 years old this year and whose interest in wood begins with the tree and carries through to the finished product. This interest embraces the engineering aspects of forestry, forest fire-fighting equipment, logging and sawmill operations, and all the subsequent machining operations that enter into the plywood, furniture, and kindred industries. The division has a fairly new committee on wood-cutting tools and equipment, and one on forest protection which works closely with the Society of American Foresters."

Power

"Even older than the Wood Industries Division is ASME's Power Division, which was organized in 1920. Power and its applications are what many people think of first when they talk about mechanical engineers, so it is natural that this meeting should have heavy emphasis on that subject. And here in the Willamette Valley, where your homes and farms are among the world's greatest users of electricity, we have an ideal setting for the discussion of man-made power."

Materials Handling

"Seven of the papers that we hear this week will be devoted to the important subject of materials handling. This field has come in for so much attention lately that people tend to think of it as a recent development. The fact is that ASME has had a Materials Handling Division since 1920, and that division has done some important work in the development of codes, standards, and general practices.

"There are other fields to be looked into here this week: fuels, safety, air pollution, hydraulics, management, gas-turbine power, heat transfer, metal processing, metals engineering, production engineering, a handful of papers sponsored by Nuclear Engineering, the second newest of our 23 professional divisions. You have only to look at your programs to see that this meeting is going to cover a lot of ground and present answers to a lot of questions."

Raise Standard of Living

"The one thing that is common to all the papers presented at this Meeting—and at all the other ASME meetings being held this year—is a reflection of the tremendous energy being expended in this country to maintain and raise our standard of living. When a man gets up—as Mr. Johnson will do this afternoon—and tells me that someone has been working on 20 different ways to strengthen a roof, I get the feeling that a lot of intelligent thought has gone toward making the American home safer, and that we have come a long way since the first cave man stepped out into the light of day and put the first roof on the first house.

"And when someone gets up—as Mr. Thompson will do later in the week—and tells me that materials-handling devices are replacing the logger's peavy, I get the feeling that this is eventually going to benefit me, in the form of lower prices for the furniture I buy."

Following his talk, Dr. Barker went to Oregon City to take part with Thomas W. Delzell, board chairman of Portland General Electric Company, in a ceremony commemorating one of the first long-distance transmissions of electricity in the United States.

It was on June 3, 1889, that one of the street-lighting circuits in Portland was run on electricity generated in Oregon City and transmitted over a distance of 14 miles, from the Willamette Falls Company's new "dynamo house" on the east bank of the river.

The result, according to a contemporary report, was "a pleasing surprise to the company, the percentage of loss of electricity by transmission being less than their most sanguine expectations."

Power Luncheon

Details of one of the most successful co-operative efforts ever undertaken between government and private industrial interests were revealed at the Power Luncheon.

James N. Landis, vice-president of Bechtel Corporation, San Francisco, Calif., praised the work leading to the formation of the five-state (Oregon, Washington, Montana, Idaho, and Utah) Governors' Power Policy Committee and the creation of an Engineering Committee to study all phases of "this many-sided and complicated problem."

Of the work done by the Engineering Committee, he said: "It should contribute immeasurably to an understanding of the issues involved and agreement of the conflicting interests on what should be done to schedule and implement the work of building the needed new power plants."

Mr. Landis said that the study of all the economic factors involved would probably lead to integrated use of both hydroelectric and steam-electric power plants "to provide the great Pacific Northwest area with firm power at less cost, to contribute to the continued development and expansion of the area's economy."

He pointed out that construction of a hydro plant costs two to four times as much as construction of a steam-electric plant, but that operation of the hydro plant is cheaper than that of the steam plant.

Spring Meeting Banquet

One of America's top forest experts said that synthetic materials are a menace to the lumber industry "only if we fall asleep."

W. F. McCulloch, dean of the School of Forestry, Oregon State College, Corvallis, delivered the feature banquet address, Tuesday, March 20.

He said that technical development is the answer to the industry's sales problems.

"Once," he said, "all we did was to cut board. Now we are expanding the number of our end products enormously. Wood is really a new chemical substance. We can compete successfully, on an economic basis, with any of the synthetics."

Dean McCulloch has been active in the field for 37 years. A graduate of the University of British Columbia and the University of Oregon, he has worked as a fireman in an Erie Railroad machine-shop steel mill, manager of a wholesale hardware store, assistant superintendent of a logging camp, and assistant forester of the State of Oregon.

He has compiled a dictionary of 4000 terms used in the old logging fields. The volume is in the hands of several historical societies which are looking for funds to publish it.

Among the terms in the dictionary are many which have come out of the logging camps and into general use in other fields:

Logrolling—originally, loggers used to stack their logs on a rollway, on the bank, before pushing them into the stream. Different camps would join forces to get the logs moving, thus giving birth to the present political meaning of the phrase.

Greasing the skids—logs used to be moved along a road made of skids. These would be greased to make the logs move more easily.

Skid road—named for the road along which the logs were skidded. The skid road used to be the heart of the logging camp. One of the famous skid roads was Yesler Way, once the heart of Seattle. The term "Skid Row" was the result of poor hearing on the part of a group of Chicago journalists passing through this territory, Dean McCulloch said.

Easy as falling off a log—self-explanatory.

Dean McCulloch heads what many consider to be the best forestry school in the nation. The school, which has graduated a total of 1460 students, celebrated its 50th anniversary a few weeks ago. Among its more famous alumni have been B. L. Orell, vice-president of Weyerhaeuser Sales Company, St. Paul, Minn., and former state forester of Washington, and George Spaur, former state forester of Oregon, now heading a forestry program in Pakistan for the International Co-Operation Administration. Other graduates are holding down responsible positions in such countries as Afghanistan, Saudi Arabia, and the Canal Zone.

Dean McCulloch said that the future is bright for the student who wants to enter the field of forestry.

"There is no limit to his opportunity," he said, "if he has lots of guts, is reasonably intelligent, and is willing to work."

He pointed out that this is especially true in this area, since forestry employs more people in the Pacific Northwest than any other industry, and brings in twice as much income in Oregon as the next leading industry.

Dean McCullough was asked whether he regretted the passing of the old logging camp. He replied that progress has been necessary for the industry, and that the only logical alternative to mechanization would have been to revert to the days of the wheelbarrow.

Asked for a specimen of colorful camp talk, Dean McCulloch told of the logger who fell out of a spar tree "so high the bluebirds built a nest on him before he hit."

Asked for a specimen of camp folksong, he responded with these lines from "The Frozen Logger":

"My lover was a logger;
"There's none like him today.
"If you poured whisky on it,
"He would eat a bale of hay."

Technical-Program High Lights

Power Generation. What was the outstanding industrial development in the Pacific Northwest between 1940 and 1954? It was the increase in electrical peak load from two million kw to more than seven million in the 14-year period.

The claim was made by John P. Buehler, executive engineer of Bechtel Corporation, San Francisco, Calif., and O. E. Walsh, vice-president of Portland General Electric Company. The area under discussion included all of Washington and Idaho, and parts of Utah, Montana, Oregon, and British Columbia.

Using figures taken from a study completed by the Pacific Northwest Governor's Power Policy Committee, the authors discussed the potential hydroelectric power developments under consideration and the existing difficulties hampering the start of many projects needed to supply future estimated loads.

The study of load growth within the area began with 1920, when the actual peak load was 700,000 kw. In the 20-year period up to 1940, the peak increased to 2 million, a total less than three times the original figure, whereas the growth in the 14-year period between 1940 and 1954 represents a growth of three and one-half times.

Over the period since 1920 the yearly average load increased 7.60 per cent; the latest 5-year period, however, has shown a yearly average increase of 9.34 per cent. Based on these computations, the estimated annual increase for the next eight years will be 6.62 per cent.

It was on this basis of estimated load growth that the authors, in their presentation, examined the ability of dependable capacity from existing, under construction, and definitely scheduled power resources to meet the estimated peak loads up to 1964. Specific examples were discussed and the physical, practical, or ideological difficulties of each were explained as they affected the completion and placing into service of sufficient capacity to alleviate the Pacific Northwest's projected growing pains.

Dutch-Oven Conversion. Converting a Dutch-oven, wood-refuse-fired boiler to spreader-stoker operation changed many operating handicaps to economic advantages for an Oregon utility. These include faster response to load changes, more applicable to combustion control, better availability for service, and excellent adaptability to multiple fuels.

The results of this experimental application were presented by R. W. Martin, Jr., chief engineer, Eugene (Ore.) Water & Electric Board. He described the conversion as the outcome of experience obtained with a new wood-refuse-fired boiler. Installed in 1950, this unit was equipped for multiple fuel firing—oil, coal, or wood refuse. The solid fuels are burned on a traveling grate having mechanical spreader-stoker feed.

According to the speaker, the good results obtained with this unit encouraged management to investigate the possibilities of installing pneumatic spreader stokers on one of the older Dutch-oven-fired boilers. Except for a few minor details, the conversion was succcessful from the start, said Mr. Martin. The difficulties, he explained, involved replacing the original grate bars with ones having smaller air openings, installing overfire air jets to secure more furnace turbulence, and reversing the connections to certain combustion-control elements. With these changes, the boiler is quite satisfactory, is much more responsive to rapid load changes, and is better adapted to automatic combustion control.

Natural Resources. Availability of large quantities of natural gas in the Pacific Northwest will bring many new industries into the area and will bring new opportunities to the established industries already here. It will do this by making possible new processes and new methods of manufacture.

That is the opinion of Robert C. LeMay. He said: "The Northwest will soon have a new choice of fuels. Faced with certain industrial expansion, it is hoped that progressive engineers here will take advantage of all appropriate new heating developments—and advance to create still more of them."

He pointed out that natural gas has many technological advantages over other fuels which are even more important than its low cost. Some of these are cleanliness, uniformity of heating, and flexibility of application—features that suit it for direct-fired applications as integral parts of automated production lines.

In addition to its use as a fuel, Mr. LeMay said, natural gas may be employed as a raw material for petrochemical products, such as ethylene, anhydrous ammonia, and methyl alcohol. Demand for these products has been increasing so rapidly that plants for their production have been, or are being, established in most areas where markets and adequate natural-gas supplies are found together. There is no reason to expect that the Pacific Northwest will be an exception to this trend, he said.

Applications discussed by Mr. LeMay in which natural gas offers advantages over other types of fuel include metallurgical uses, food baking and drying, brazing, glass working, varnish cooking, and direct heating of flowing aqueous materials.

Power Industry. Continued development of hydroelectric sites is still the best bet for the Pacific Northwest's power industry, in spite of the fact that nuclear power plants may some day displace steam-generating plants. On the other hand, although capital investment costs still favor hydroelectric development, the pic-

S. H. Graf, *left*, consulting engineer, Corvallis, Ore., and chairman of the Metal Processing-Production Engineering-Metals Engineering Session of the Spring Meeting, discusses program with S. R. Carpenter, supervisor of producibility, Convair, a division of General Dynamics Corporation, San Diego, Calif.

Ralph Kress addresses the Gas Turbine-Power Session of the 1956 ASME Spring Meeting, held at the Multnomah Hotel, Portland, Ore., March 18–21

ture may change after actual costs of nuclear plants are available for study, making it wise for utilities to delay expansion until the picture becomes clearer.

In substance, these are the conclusion of studies made by several sponsoring agencies in this area and summarized in a talk by Kenneth M. McCaffree, assistant professor of economics at the University of Washington, Seattle. He cited one agency's report that all available evidence indicates that nuclear steam-electric plants will not be competitive with hydroelectric plants, costwise, for a number of years. He cautioned, however, that the inadequacy of detailed data on a large number of undeveloped hydro sites makes a positive prediction unwarranted. He said: "Even though nuclear power may not be economically competitive in 1958, it is also possible that hydro sites as well should not be developed at this time. The expansion of electricity-generating facilities is a long-run investment. It might not be possible, under certain circumstances, to recover fully the investment in new hydroelectric developments.

"The rate in reduction in costs of nuclear power could be so great that by waiting a few years, say, until 1962–1963, to invest in new power facilities, the economic advantages of nuclear over hydroelectric power would be so great that the delay in providing new facilities immediately would be a profitable move."

Weatherman Joins Engineers' Team. To help him in the complex science of determining plant locations, the engineer has called in a new aide—the weatherman.

Just how important climate is in the constructions, operation, and maintenance of an industrial plant was outlined by Glenn R. Hilst, head of the Meteorology Unit, and James J. Fuquay, research meteorologist, both of General Electric Company's Radiological Sciences Department, Richland, Wash.

Among the factors to be considered in construction, they said, were the following:

1 Frequency and duration of certain air temperatures, wind speeds, blowing dust, and other phenomena which affect the comfort and safety of outdoor workers.

2 Temperature and humidity affecting the pouring of concrete.

3 Possibility of freezing rain, which may halt steel erection.

4 Total precipitation, which determined the amount of drainage required to assure continuous construction.

Construction of atomic-energy installations raises special questions, they said, since "it is important to appraise the problem which would have to be faced in the case of a serious incident resulting in the release of substantial quantities of radioactive or otherwise toxic materials."

Materials Handling in Steel Plants. Introduction of heavy-duty straddle railroad-switching equipment for the handling of steel in steel plants has produced savings enough to pay for the carrier in less than a year. As a result, applications in the steel industry have been on the increase ever since the first application, according to Carl Knapp, application engineer of Clark Equipment Company, Benton Harbor, Mich. He gave the average amount of material as 64 tons per hr for a truck of 50,000-lb capacity, and reported the hourly operating cost as $6.10. These figures indicate an average cost of 9.53 cents per ton of steel handled, which compared with 15 cents per ton for railroad-switching equipment.

Low-cost storage areas were also indicated as one of the advantages of straddle truck-handling systems, since they permit removal of materials from under craneways, where space is valued in some instances at $12 per sq ft, to areas worth, in some instances, only 10 cents per sq ft. Thus floor space can be used more effectively for production facilities.

A truck of 50,000-lb capacity straddles a space 62 in. wide and 72 in. high. Length of loads is unlimited. Each load requires a set of two bolsters, usually of steel and joined together. Approximately 250 sets are in use with each carrier. Bolster design varies considerably and is dictated by the type of materials available, including scrap steel, and by other types of handling equipment used to fill them or to carry them, such as fork trucks and cranes. Cost of one-piece bolsters is $85 to $90 each. Although this investment adds up to about the same cost as the carrier, it was pointed out that it is only a fraction of the investment required for equivalent storage capacity in railroad gondolas.

Drying Sawmill Residue. One of the problems involved in using sawmill residue for wood briquettes, briquetted fuel, particle board, hardboard, and molded products has been how to find an economical, high-capacity method of drying the residue.

A solution for this problem is called suspension drying, and involves introducing the particles into a hot gas stream—500–1500 F—where they are conveyed and at the same time dried by contact with the gas.

The process, which achieves drying in a matter of seconds, has already been used to dry other materials, including coal, bark, starch, and lignite.

Stanley E. Corder, Charles O. Morris, and George H. Atherton, all of the Oregon Forest Products Laboratory, Corvallis, where the method was tested, described the process in their paper. They reported that an experimental sawdust-suspension drier gave maximum efficiencies of 70–80 per cent. Results indicated, they said, that suspension drying should be limited to materials with particle sizes of $1/4$ inch and smaller, since drier capacity and efficiency dropped sharply as particle size increased.

The investigation was undertaken to determine the effects of gas-inlet temperature, gas-flow rate, sawdust feed rate, sawdust initial moisture, and sawdust particle size.

Electrical Requirements for Aircraft. Electrical requirements for aircraft have grown so great that engineers have turned their attention to auxiliary sources of power, according to Ralph Kress, senior design engineer of Solar Aircraft Company, San Diego, Calif. He pointed out that the Wright brothers' plane of 1903 required electricity only for the ignition. Lindbergh's plane added only the need for running lights.

Today, he said, electricity is needed for conventional comforts, such as cooking, refrigeration, lighting, pressurization, and air conditioning. Complicating the problem is the fact that navigational and communication devices, such as radio and radar, require a specialized type of power, constant-frequency alternating-current.

Another problem occurs when the plane is on the ground and therefore cannot take power off the main propulsion engines.

An answer to these problems, Mr. Kress said, lies in the use of auxiliary generators driven by gas turbines. He described a unit built by his firm for use on the Convair C-131B.

The advantages include low weight-horsepower ratio, small size in relation to horsepower, ability to start and operate at low temperatures, ease of maintenance, ability to operate on a variety of fuels, high flywheel effect, and simple operating controls.

Mr. Kress described several designs of gas-turbine auxiliary sets and explained how they are mounted in pods attached to the underside of the plane by means of standard bomb shackles. Provisions are installed in the cockpit for jettisoning the units in case of an emergency wheels-up landing.

Mobile Gas-Turbine Power-Generating Plant. Details of America's first mobile gas-turbine power-generating plant were revealed by Harry H. Rupp, Lester, Pa., and William N. Hornberger, San Francisco, Calif., both employed by Westinghouse Electric Corporation.

The original plant, they said, was built for the U. S. Army. It is expected to find use in case of service interruption because of enemy attack, local disaster, flood, fire, drought in hydro-power regions, or other conditions.

Even though distribution systems are interconnected to permit interchange of energy under adverse situations, local-disaster conditions can disrupt service badly needed for rescue and reconstruction purposes. A quick means of supplying this emergency power, therefore, becomes of paramount importance.

Such mobile generating plants should preferably be of substantial capacity commensurate with mobility. In general, efficiency would be secondary to the availability and speed with which service could be restored.

The gas-turbine power plant is light and compact, and can be built with substantial unit capability. Other advantages are that (1) it can be put into service and loaded rapidly, (2) it requires no water for cooling purposes, and (3) the simple cycle provides moderate thermal efficiency.

The Army plant is mounted on two 54-ft-long railway cars. One car contains the gas-turbine-generator unit, all its auxiliaries, and the auxiliary control panel. Fuel-oil day tanks are located beneath this car. The second car provides space for the 6250-kilovolt ampere outdoor-type transformer, 150 and 50-kilowatt starting and auxiliary diesel-engine sets, switchboards, turbine remote-control panel, car-heating and air-conditioning equipment, storage battery and axle-driven generator.

The gas turbine operates on the simple cycle of the combustion gas passing into the turbine with direct exhaust to the atmosphere. Incoming air is compressed to 6 atmospheres for introduction into the combustion chamber. Full-load thermal efficiency is 18.5 per cent.

To facilitate maintenance, a continuous horizontal joint is provided in the combined compressor and turbine casing, with vertical joints between each component. Hence the covers may be lifted individually or as a unit without disturbing the rotating element. The stationary blading is in an assembly that easily can be removed from both the top and bottom sections of the casing without disturbing the rotor.

Inspection Trips

Four extremely interesting inspection trips rounded out the Spring Meeting program. These trips included visits to the Hyster Company, manufacturers of material handling, logging, and construction equipment for world-wide distribution. The visitors saw this modern factory in full operation.

The trip to the Crown Zellerbach Paper Mill, Camas, Wash., showed the entire process of paper manufacture and fabrication from the logs to finished products. There was a trip to Mount Hood which afforded an opportunity to relax and enjoy the scenery, some snow sports, and dinner at the well-known Timberline Lodge.

An all-day trip to the Columbia River Hydro Power System included a stop at the Multnomah Falls, an inspection of the 10-unit 600,000-kw powerhouse at Bonneville Dam, and luncheon at the old pioneer town of The Dalles. The afternoon was spent viewing The Dalles Dam which is really a large hydropower project in its fourth year of construction.

At the Weyerhaeuser Timber Company, Longview, Wash., the visitors saw trees converted into many and various forest products. In addition to lumber, plywood, and pulp, this plant supplies raw material in the form of fibers and wood chemicals to producers of nearly 4000 items in every-day use. Longview is an outstanding example of a planned city that owes its existence to the production of forest products.

An added feature of this trip was the Wood Industries Division Luncheon at the Monticello Hotel. Everett Barton, public-relations director, Weyerhaeuser Timber Company, spoke on "Modern Materials That Come From a Log."

Women's Program

While the women who attended the meeting were welcome to attend all the social functions of the program, a special program was arranged for their particular enjoyment.

Their itinerary included a trip to the Art Museum where they viewed the World Premier showing of paintings from the Walter P. Chrysler, Jr., collection. This collection comprises over one-hundred paintings from the works of sixteenth to twentieth-century artists including Rubens, Rembrandt, Goya, Gainsborough, and Van Dyck.

The following day there was a tour of the Jantzen Knitting Mills. Here the exhibition was concerned with twentieth-century artistry in swim suits, sweaters, and skirts. This visit was followed by a luncheon at Kamm House and a tour of the Colony. The Colony is a collection of early residences of Portland, which today includes a restaurant and some shops as well. The restored residences show the beautiful and lavish woodwork decoration used in early Portland.

The program concluded with a most enjoyable trip to majestic Mt. Hood and dinner at Timberline Lodge.

Committees

At the conclusion of the Spring Meeting, on Wednesday, March 21, Dr. Barker called it "one of the most successful we have ever staged."

Dr. Barker especially praised the work of the Oregon Section, host to the Meeting, in planning and carrying out the Meeting which "in terms of enthusiasm, programming, and significance of subject matter, will go down as one of the better ASME meetings in our 75-year history."

Chairman of the General Arrangements Committee was Robert E. Wiegand, manager of the Industrial Sales Division of Brod & McClung. Assisting him were Kurt Siecke, Gordon Tupling, Calvin E. Redfern, Bertram G. Dick, Frank A. Fern, Stan P. Kallo, Fay Brainard, Mark Clayton, and Mrs. B. G. Dick.

Availability List for 1956 ASME Spring Meeting Papers

THE papers in this list are available in separate copy form until Jan. 1, 1957. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
Fuels	
56—S-14	Processes and Product Improvements to Be Anticipated With Natural Gas, by R. C. LEMAY
56—S-21	Wood-Refuse Spreader-Stoker-Firing of Two Steam Generators, by R. W. MARTIN, JR.
Gas Turbine Power	
56—S-10	A Pod-Mounted Gas-Turbine-Driven Auxiliary Power Unit, by R. KRESS
56—S-11	The Versatile Gas Turbine, by H. R. SCHELP
Heat Transfer	
56—S-20	Selection of Optimum Configurations for a Heat Exchanger With One Dominating Film Resistance, by E. R. G. ECKERT and T. F. IRVINE
56—S-22	Flow Through Annular Orifices, by K. J. BELL and O. P. BERGELIN
Materials Handling	
56—S-1	Outstanding Material-Handling in the Pulp and Paper Industry on the West Coast, by F. D. HELVERSON
56—S-2	The Design of Overhanging Attachments for Crawler Tractors, by R. C. SHOEMAKER
56—S-3	High-Pressure Pneumatic Conveying in the Lumber Industry, by I. A. RADER
56—S-4	Handling Timber With the Fork-Lift Truck and Material Carrier, by N. D. THOMPSON
56—S-5	Modern Material Handling as Employed by Boeing Airplane Company Seattle Division, by BAYNE LAMB
56—S-6	The Carrier Method of Handling as Applied in the Steel Industry, by CARL KNAPP

Metal Processing

56—S-13 High-Flying Ti, by S. R. CARPENTER

Power

56—S-7 Portable 5000-Kw Railway and Skid-Mounted Gas-Turbine Power Plants, by H. H. RUPP and W. N. HORNBERGER

56—S-8 Integration of Steam and Hydro-Power in Northern California, by WALTER DREYER

56—S-9 Hydro-Power in the Northwest, by J. P. BUEHLER and O. E. WALSH

56—S-12 The First Commercial Steam Generator at Supercritical Pressure, by J. D. ANDREW, JR.

56—S-19 An Economic Appraisal of Nuclear Versus Hydro-Power Development in the Pacific Northwest, by K. M. MCCAFFREE

Wood Industries

56—S-15 Glued Laminated Timber Construction, by V. KETCHUM

56—S-16 Lateral Tests on Full-Scale Lumber —And Plywood-Sheathed Roof Diaphragms, by J. W. JOHNSON

56—S-17 How R-F Concerns the Wood Industry, by J. W. MANN

56—S-18 Suspension Drying of Sawdust, by S. E. CORDER, C. O. MORRIS, and G. H. ATHERTON

J. W. Barker, ASME President, Urges Professional Survey of Education

JOSEPH W. BARKER, President of The American Society of Mechanical Engineers, warned Portlanders against being too complacent about the results of a recent survey which showed local schools running ahead of the national average in the number of students electing arithmetic courses.

Speaking at a luncheon meeting of the Professional Engineers of Oregon in the old Heathman Hotel, Portland, Ore., Wednesday, March 21, Dr. Barker said: "The results are impressive, but they do not tell the whole story. The fact that these children are studying arithmetic does not mean that they are learning arithmetic. Neither does it mean that they are learning the solid and plane geometry and trigonometry that they will need for their engineering and science courses in the colleges."

He cited a survey made a few years ago at Oregon State College which established that 36 per cent of the freshman class could not pass an examination in elementary-school arithmetic.

The same survey showed that more than half of the class had to take make-up courses in mathematics because they could not pass their entrance examinations, and that only about 10 per cent of them could pass an algebra examination and qualify for beginning college mathematics.

Dr. Barker, who was in Portland for the ASME Spring Meeting, outlined a four-point program for his audience:

1 A committee should be established in each locality to find out what is going on in the schools. This committee could work on its own, or through established organizations.

2 An attempt should be made to evaluate the quality of the instruction. This can be done by using standardized tests which would provide an index of local progress as compared with that in the rest of the country. In addition, teacher qualifications should be examined.

3 A follow-up survey should be made, to discover what happens to pupils when they apply for admission to colleges.

4 Committees should be set up to work with mathematics teachers in an effort to improve the quality of instruction.

ASME Instruments and Regulators Division Conference Discusses Nonlinear Control Systems

THE second annual conference of the Instruments and Regulators Division of The American Society of Mechanical Engineers held at Princeton University, Princeton, N. J., March 26–28, discussed nonlinear control systems and some outstanding new developments in the nonlinear field were announced.

The registration totaled 241; technical-session attendance was approximately 200; and more than 130 were present at the banquet. The conference was cosponsored by the Feedback Control Systems of the American Institute of Electrical Engineers and the Trenton Subsection of the ASME Philadelphia Section.

In addition to the six regular technical sessions, which were held in the Frick Auditorium, there were eight important committee meetings held at the Princeton Inn, covering such subjects as design, terminology, eduction, application, theory, and long-range planning.

The Availability List of IRD papers will be found in the Technical Digest section of this issue on pages 464-465.

C. A. Ludeke, University of Cincinnati, began the conference by demonstrating nonlinear phenomena visually and audibly with chalk talk, slides, motion pictures, and working models. Assemblies of springs, eccentric weights, sticky bearings, a belt sander, and surplus motors ranging from two-hp to "Erector-set" size whirred, scraped, ground, and thumped out the principles. He developed odd-order subharmonics that occur in second-order systems with exponential restoring effects and demonstrated frequency entrainment.

At the banquet on the evening of March 27 at the Princeton Inn, the Division awarded honors to J. B. Reswick and T. P. Goodman for their paper, "Determination of System Characteristics From Normal Operating Records," presented at the first Instruments and Regulators Conference held at the University of Michigan, April 25–26, 1955. Thus the series of IRD conferences to be held at another university each year began.

W. G. Brombacher, past-chairman of the Division's Executive Committee, was honored in recognition of his work in standardizing and classifying measuring instruments and their literature sources.

Frank W. Notestein, director of the Office of Populations Research in the School of Public and International Affairs at Princeton University, was the banquet speaker. The subject of his talk was "The Dynamics of Populations."

The third IRD Conference is scheduled to be held at Northwestern University, Evanston, Ill., in March, 1957. The technical papers of that meeting will consider control of physical systems in the presence of random disturbances.

W. G. Brombacher, *left,* receives IRD Award in recognition of his work in standardizing and classifying measuring instruments and their literature sources from R. E. Clarridge, chairman, IRD, during conference held at Princeton University March 26–28

J. B. Reswick, *left,* and T. P. Goodman, *center,* receive award for their paper "Determination of System Characteristics From Normal Operating Records," presented at the first IRD Conference, Ann Arbor, Mich., April 25, 1955, from R. E. Clarridge, IRD chairman

Checking the program as ASME OGP Conference gets under way, *left to right,* are: Walter J. Verlander, chairman, New Orleans Section; R. P. Lockett, Jr., chairman, General Arrangements Committee; James M. Todd, past-president and Fellow, ASME, and toastmaster at the welcoming luncheon; and Harold C. Teasdel, president, California Company, and luncheon speaker. His topic was "Oil and Gas Power and Off-Shore Development." OGP Conference was held April 1–5 at the Jung Hotel, New Orleans, La.

28th ASME OGP Conference and Exhibit in New Orleans Attracts Large Audience

The 28th annual conference and engineering exhibit of the Oil and Gas Power Division of The American Society of Mechanical Engineers were held at the Jung Hotel in New Orleans, La., April 2–5. Attendance was up to expectations, the total being 550 including 93 women registrants.

Joseph W. Barker, ASME President, who was present at the conference throughout the full five days of its duration, was the principal speaker at the annual banquet, Wednesday evening. His subject was "The New Business of Research." His talk was received enthusiastically by the banquet guests numbering more than 250. Edwin J. Schwanhausser, president, Worthington Corporation, Harrison, N. J., acted as toastmaster at the banquet. J. M. Todd, past-president and Fellow ASME, served as toastmaster at the Welcome Luncheon. H. C. Teasdel, president, California Company, luncheon speaker, discussed the subject "Oil and Gas Power and Off-Shore Development."

Technical Events

The technical program brought an excellent variety of material to the conferees. Technical papers were selected especially to interest the pipe-line pumping-station operators and marine personnel who attended the conference.

Two panel discussions added zest to the proceedings, one on "Torque Converters and Fluid Couplings—Their Application and Performance," and the other on "Marine-Engine Maintenance." These panel discussions have become splendid media for the exploration of timely subjects, stimulating as they do free expression of opinion from the floor.

Chosen for citations for outstanding service to the oil and gas-power industry were: George Noltein, Tampa, Fla; Lewis W. Downey, West Palm Beach, Fla.; and Henry Schrenck, Brooklyn, N. Y. (posthumous). Awards for outstanding papers were given to Kenneth R. Mercy, Brooklyn, N. Y., for his paper on "Analysis of the Basic Noise Sources in the Diesel Engine"; to John J. McMullen, Washington, D. C., for his paper on "A Free-Piston Propulsion Plant for a Liberty Ship"; and to D. H. Tsai, Washington, D. C., for his paper on "Effect of Size on the Inlet System Dynamics in Four-Stroke, Single-Cylinder Engines."

Retiring chairman of the OGP Executive Committee, following a successful year, was J. C. Barnaby, one of the industry's oldtimers. Succeeding him in the OGP chair is P. B. Jackson who has for many years been the Aluminum Company of America's special representative to the diesel industry and who enjoys the distinction of having attended every one of OGP's 28 annual conferences.

Engineering Exhibit

There were 39 exhibits featuring, in addition to diesel engines themselves, a wide range of parts and accessories, instrumentation, torque converters, fuel-injection equipment, turbochargers, lubricants, and services. The exhibits were interesting and instructive as usual.

Outstanding OGP authors honored at conference. Seated, *left to right,* are P. B. Jackson, chairman, OGP Division, and ASME President J. W. Barker. Standing, *left to right,* are J. J. McMullen, recipient of Outstanding Paper Award; J. C. Barnaby, outgoing OGP chairman; and recipients, K. R. Mercy and D. H. Tsai.

The New Orleans Section of ASME, host to the conference, made excellent use of the extraordinary local attractions in providing entertainment for the women guests. In addition to being invited to all of the special functions of the conference, the women were taken on a tour of the French Quarter; a visit to Garden District homes; and a harbor trip on the yacht, "Good Neighbor," the latter as guests of the Board of Commissioners of the port of New Orleans.

Spread on the records of the Oil and Gas Power Division was a special vote of thanks to the host Section for its careful preparation before, and untiring co-operation during, the Conference.

Location of the 1957 annual OGP Conference will be the Kentucky Hotel, Louisville, Ky., May 20–23.

Availability List for 1956 ASME Oil and Gas Power Conference Papers

THE papers in this list are available in separate copy form until April 1, 1957. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
56—OGP–1	Heavy Fuel and Cylinder Wear in Marine Diesel Engines, by J. M. A. VAN DER HORST
56—OGP–2	The Performance of Controllable Pitch Propeller in River-Towboat Operation, by R. F. CLARK
56—OGP–3	Experiences With Aluminum Bearings in Heavy-Duty Engines and Compressors, by J. P. HYDE
56—OGP–4	Recent Developments in Gas-Engine Ignition, by R. B. CLARK
56—OGP–5	Maintenance Practices in a Large Internal-Combustion Power Plant, by H. KEEFER
56—OGP–6	A Combustion System for Spark-Fired Gas Engines Using Diesel Compression Ratios, by L. D. THOMPSON, R. H. BEADLE, and F. A. BLAKE
56—OGP–7	The Measurement of Engine Response to Sudden Load Changes, by L. T. BRINSON, JR., and E. C. SCHUSTER
56—OGP–8	Rating Engines by Fuel-Air Ratio Effects, by R. J. CRAMER, JR., and K. F. FROEHLICH

Engineers Study Ferrites at Harvard University Meeting

MODERN cousins of the ancient lodestone—that have more than doubled the efficiency of radar and microwave operations—drew 400 engineers and physicists to Harvard University, Cambridge, Mass., April 2–4, 1956.

For three days they studied the ferrites—a group of magnetic nonconductors. This group of solid-state materials ranks with the transistors in importance to recent communications engineering. Since applications were designed in 1950, the ferrites have been built into nearly every modern radar and microwave network. The engineers are searching for further uses of ferrites in electronics.

The meeting was sponsored by Harvard's Division of Engineering and Applied Physics, the Air Force Cambridge Research Center, and the Professional Group on Microwave Theory and Technique of the Institute of Radio Engineers.

Achievements already racked up for the strange new substances include:

1 Simultaneous sending and receiving on a single microwave antenna. This means, for instance, continuous search by radar, instead of the intermittent "pulse" sending and receiving of World War II.

2 Full-power transmission, with practically no power loss, in microwave ranges (from 100 megacycles to 100,000 megacycles). Before the introduction of ferrite "isolators," the output of 10 watts of power at the transmitter delivered only 5 watts at the antenna—more than half of the wattage was lost through "padding" which was necessary between transmitter and antenna.

3 Eliminating frequency drifts in microwave transmission.

The secret of the ferrites is that they defy "the theory of reciprocity." This says that any mechanical, optical, or electrical system will work equally in either direction: If an impulse travels through the system from *A* to *B*, a similar impulse will travel through the same system from *B* to *A*.

A microwave system with a ferrite isolator, however, will carry microwaves from transmitter *A* to antenna *B* without power loss, but will block off loss wattage returning from antenna *B* to transmitter *A*. This permits a sending station to launch its microwaves at full strength, without loss or interference.

Similar results are gained in other applications.

The natural ferromagnetic materials known to physics up to 10 years ago—iron, nickel, cobalt, and their alloys—were all electrical conductors. This prevented their effective use in microwave work. The ferrites are magnetic, but they resist electrical current.

The one exception to this rule of nonconductivity is the chemical model of all the ferrites—the lodestone. The lodestone—magnetic iron oxide (Fe_3O_4)—is a "solid solution" of two iron oxides (FeO and Fe_2O_3).

In preparing the ferrites which are nonconductors of electricity, one of the iron-oxide molecules in the lodestone formula is replaced by the oxide of another metal (nickel oxide (NiO) plus iron oxide (Fe_2O_3), for instance). This has been done with a wide range of metals—manganese, magnesium, cobalt, copper, cadmium, zinc. The two oxides are mixed with a wax medium and fired to temperatures of approximately 2200 F.

And in each case, the product—similar in chemical and crystal structure to the ancient lodestone—is magnetic and resistant to ordinary electric current.

C. Lester Hogan, associate professor of applied physics at Harvard, developed basic applications of ferrites to microwave technology five years ago at the Bell Telephone Laboratories. He was in charge of arrangements for the three-day meeting.

At a banquet at the Hotel Commander, Cambridge, Mass., on Tuesday night, April 3, A. C. Beck of the Institute of Radio Engineers, presented the annual award for an outstanding contribution to the microwave art on behalf of the Professional Group on Microwave Theory and Techniques of the Institute of Radio Engineers. The award went to Herman N. Chait and Nicholas G. Sakiotis of Naval Research Laboratory.

Aerial view of Montreal, Que., Can., host city to the EIC-ASME Meeting which will be held at the Mount Royal Hotel, May 23–25, 1956

Detroit Industry Engineering-Training Program Implements ECPD Program

ENCOURAGED by the outstanding success of the Cincinnati (Ohio) Engineers' Council for Professional Development Training Committee and its Program for Engineering Professional Development during the First Five Years, the Engineering Society of Detroit has launched a comprehensive approach to the problem for the Detroit area. The developing Program is administered by the Industry Training Committee of the Engineering Society of Detroit. Its chairman is Edwin L. Yates (ECPD), General Motors Corporation, and the secretary, A. L. Hellwarth (ECPD), of the Detroit Edison Company. The over-all purpose of the Detroit effort is to implement locally (as in Cincinnati) the Engineers' Council for Professional Development Six-Point Program for the young engineer's first five years of professional development. Detroit realizes that one of its most valuable assets is its young graduate engineers, but:

"As they enter employment, these young men represent an undeveloped resource. For the most part they lack the practical and intimate knowledge and experience in applied engineering and the familiarity with policies, methods, and practices of their particular employer, which they need to make themselves most useful. They are eager to learn. Most of them can and will obtain this essential information on their own initiative if given time. They can go much faster and farther, however, if they are given help and encouragement by their employers in the form of specific training programs. Loss of time in developing these men means possible discouragement and a waste of dollars and manpower. It is of very real practical advantage to both the young engineer and to his employer that he become a well-rounded professional engineer in the shortest possible time."

The objectives of the Detroit program are therefore:

1 To stimulate interest among the employers in Detroit industry in the needs and advantages of development programs for their young engineers.

2 To provide specific information and assistance on the organization and contents of such programs.

3 To find means for maintaining future continued interest and progress in engineering training among Detroit employers.

The Industry Training Committee is preparing and publishing seven booklets. The first is an introduction to the program. Each of the remaining six will be devoted to the following principal points in the ECPD Professional Development Program:

1 Orientation and training in industry
2 Continued education
3 Integration into the community
4 Professional identification
5 Self-appraisal
6 Selected reading

The introductory booklet (no charge) and the booklet on "Orientation and Training in Industry" ($1 a copy) are available from the Industry Training Committee, The Engineering Society of Detroit, 100 Farnsworth Avenue, Detroit 2, Mich. The remaining booklets are now in preparation and will be published in the near future. They are available to interested persons regardless of location.

Meetings of Other Societies

May 9–11
Investment Casting Institute, spring meeting, Hotel New Yorker, New York, N. Y.

May 10–11
Atomic Industrial Forum and Southwest Research Institute, Atoms-in-Business Conference, Hotel Plaza, San Antonio, Texas

May 10–11
Operations Research Society of America, fourth annual meeting, Sheraton Park Hotel, Washington, D. C.

May 14–16
President's Conference on Occupational Safety, Washington, D. C.

May 16–18
Society of Experimental Stress Analysis, spring meeting, Hotel William Penn, Pittsburgh, Pa.

May 17–18
President's Committee on Employment of the Physically Handicapped, annual meeting, Washington, D. C.

May 17–18
Society for Advancement of Management, Material Handling Conference, Hotel Statler, New York, N. Y.

May 21–23
American Petroleum Institute, midyear meeting, Atlanta Biltmore Hotel, Atlanta, Ga.

May 23–24
American Iron and Steel Institute, general meeting, Waldorf-Astoria Hotel, New York, N. Y.

May 23–25
American Management Association, general management conference, Hotel Roosevelt, New York, N. Y.

May 24–26
Armed Forces Communications and Electronics Association, tenth national convention, Hotel Statler, Boston, Mass.

May 30–June 9
International Conference on Large Electric Systems (CIGRÉ), 16th convention, Paris, France

June 3–6
American Gear Manufacturers Association, fortieth annual meeting, The Homestead, Hot Springs, Va.

June 3–6
American Society of Refrigerating Engineers, annual meeting, Sheraton Gibson Hotel, Cincinnati, Ohio

June 3–8
Society of Automotive Engineers, summer meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 4–6
Edison Electric Institute, twenty-fourth annual convention, Atlantic City, N. J.

June 4–7
Forest Products Research Society, tenth national meeting and FPRS suppliers exhibit, Asheville, N. C.

June 4–8
American Society of Civil Engineers, convention University of Tennessee, Knoxville, Tenn.

June 4–9
International Mechanical Engineering Congress sixth congress, Paris, France

June 6–8
American Society for Quality Control, tenth annual convention, Mount Royal Hotel, Montreal, Que., Can.

June 6–8
The American Nuclear Society, annual meeting, Palmer House, Chicago, Ill.

June 7–8
European Federation of Chemical Engineering (DECHEMA), thirty-first annual congress, Frankfurt am Main, Germany

June 11–15
Society of the Plastics Industry, conference and annual meeting, Commodore Hotel, and seventh national plastics exposition, Coliseum, New York, N. Y.

June 12–15
Max Planck Society for advancement of sciences, general assembly, Stuttgart, Germany

(*ASME Coming Events, see page 482*)

Coming Meetings

Materials Handling

THE First National Material Handling Conference of the Society for Advancement of Management will be held on May 17–18 at the Hotel Statler in New York, N. Y. Programmed to provide practical, cost-conscious discussion of all phases of material handling, the Conference will set the goals for achieving mechanized and automatic material handling for executives and engineers in any industry with responsibility for manufacturing costs and efficiency.

Material-handling costs range from 25 to 60 per cent of total manufacturing labor costs. It offers today's biggest avenue for cost reduction, improved manufacturing efficiency, and competitive advantage. The great problem is to mechanize material handling better and on a larger scale—thus the theme, "Management's Goal—Mechanized Material Handling."

Atomic Energy

A NATIONAL conference for over 400 leaders of the atomic and mining industries, the financial world, government, and education will be held June 25–26 in Denver, Colo., at the Cosmopolitan Hotel, under the joint sponsorship of the Atomic Industrial Forum, Inc. and the Denver Research Institute.

The conference, entitled "Uranium and the Atomic Industry," will for the first time bring top officials of atomic manufacturing companies and utilities to the heart of the uranium-producing area for a joint conference with leaders of the mining industry.

Instrumentation

THE Instrumentation Conference of the Gordon Research Conferences (AAAS) will be held July 23–27, 1956, at Colby Junior College, New London, N. H. Eight major papers and 21 additional papers are scheduled for presentation by leaders in the field representing research, education, and industry both at home and abroad. Registration is limited to one hundred. Applications for attendance should be sent to Dr. W. George Parks, University of Rhode Island, Kingston, R. I.

Artist's conception of recently completed New York Coliseum which occupies one mast block between 58th and 60th Street, facing Columbus Circle. Only outside decoration is four aluminum sculpture seals by the sculptor Paul Manship.

New Coliseum in New York Schedules Major Trade and Industrial Expositions

Expositions signed up at record-breaking pace at New York Coliseum again proves New York is the "showcase" of the world

Twenty-two major trade and public expositions are to appear at the New York Coliseum the last eight months of 1956 according to Arthur Smadbeck, president, Coliseum Exhibition Corporation. Ten of these are new shows which will make their debut at the giant exhibition hall completed in April on Columbus Circle in the heart of Manhattan.

ASME Power Show

Among the expositions announced by Mr. Smadbeck are long-established shows which are being greatly expanded in anticipation of wider exhibitor participation and increased attendance drawn by the Coliseum's modern facilities and convenient location. One of these, the National Exposition of Power and Mechanical Engineering, sponsored by The American Society of Mechanical Engineers, will be held November 26–30.

Coliseum Designed for Exhibits

The Coliseum will be the largest exhibition hall of its kind in the world and is the most modern building designed solely for exhibition and trade-show use. It is designed to handle large expositions utilizing the entire four floors or smaller shows using only one or two floors. As many as four shows can run concurrently.

The Coliseum's four floors are fully air-conditioned to control heat and humidity for crowds as large as 35,000 persons at one time. The air-conditioning installation is one of the largest single contracts of its kind ever negotiated.

Everything in the Coliseum has been designed to help shows move in and out quickly and handle large crowds efficiently and comfortably.

The Coliseum has in operation one of the largest elevators ever built, 49-ft long and capable of lifting 38 tons from street level to any one of the four floors. Four additional freight elevators serve every exhibit area. The large elevator will lift combination truck and trailer units; the others will lift larger than normal truck loads.

Truck ramps lead from both the north and south sides of the Coliseum. The ramp from the south side will handle two truck and trailer combinations side by side. Total unloading dock space is more than 120 ft. The truck dock is equipped with levelators which can be raised or lowered to truck-body level to ease the moving of heavy or bulky loads.

Visitor traffic in the Coliseum will be handled by seven escalators with a capacity of 40,000 persons per hr. Passenger elevators will carry an additional 200 persons at a time. The lobby, 70 × 250 ft, will handle one show using all four floors at once or can be divided to accommodate two, three, or four shows running at the same time. Marquees, ticket offices, escalators, elevators, and storage can be similarly utilized to handle separate shows.

The Coliseum is expected, directly and indirectly, to spark a wide rebuilding and modernization program for the entire area in which it is situated. Owners of hotels and restaurants in the immediate vicinity are already at work refurbishing and upgrading their facilities to take care of expected increase in business from Coliseum events.

In addition, there are a number of plans being studied by the city and others to create a cultural center near Columbus Circle as well as widespread new housing in the area north of Columbus Circle.

Expositions for June–December

A partial list of expositions that would be of interest to mechanical engineers which will appear at the Coliseum in the June–December period with approved dates of their appearance follows. Several additional shows have signed to appear, but have not approved release of dates.

Date—1956	Event	Floor
June 11–15	National Plastics Exposition	1, 2
June 11–15	21st National Oil Heat and Air-Conditioning Exposition	3
Sept. 17–21	Instrument Society of America	1, 2
Oct. 1–5	National Hardware Show	1, 2, 3, 4
Oct. 15–19	National Business Show	1, 2
Oct. 14–16	International Sanitation Maintenance Show	3
Nov. 26–30	National Exposition Power and Mechanical Engineering	1, 2

Institution of Engineers, Australia, Invite ASME Members

The members of The American Society of Mechanical Engineers who contemplate attending the Olympic Games to be held in Melbourne, Australia, November, 1956, have been invited to avail themselves of the opportunity of inspecting engineering works and industries in the State of Victoria by C. H. D. Harper, secretary, The Institution of Engineers, Australia.

Members planning such a trip are requested to write to the Hospitality Officer, The Institution of Engineers, Australia, Kelvin Hall, 55 Collins Place, Melbourne, giving details of the time they will spend in Australia, their particular interests, and anything they would wish particularly to see.

Junior Forum

Conducted for the National Junior Committee

by R. A. Cederberg,[1] Assoc. Mem. ASME

Report From Portland

By Vernon R. Hill[2]

THE Junior-Management-Education session during the ASME Spring Meeting held at the Multnomah Hotel, Portland, Ore., March 18–21, was a "roaring" success. I say this mainly because of the lively discussion that followed the presentation of each paper.

Papers and Discussions

The first paper to be presented was "Building Professional Future" by Robert F. Steidel, Jr.[3] Dr. Steidel recommended that young engineers attain at least a master's degree, become registered as a professional engineer in the state of residence, and select proper professional associations such as the fine people one meets in the ASME.

A written discussion by S. J. Brady[4] (not present) was read by the Session Vice-Chairman, Harry M. Banfield, Jr.[5] Mr. Brady agreed with the major points made by Dr. Steidel and went on to say that the young engineer should seek the counsel of professors and practicing engineers and choose summer or part-time jobs in engineering in order to determine the most promising direction to follow in his career. He felt that joining the ASME would continue to be a matter of individual choice. He also pointed out that while acquiring an advanced degree was increasing in popularity the rate was slow especially for those who intended to go into management.

Oral discussions were presented by John Talbot, Oregon Steel Mills, Portland, Ore.; Milton B. Larson, Oregon State College, Corvallis, Ore.; Jim Lynch, Worthen and Wing, Seattle, Wash.; and John R. Deffenbaugh, Gabriel Boiler, Portland, Ore. A heated discussion ensued when Mr. Larson stated that he thought the examination required for professional registration was too easy, and that some of the problems were copied directly from school textbooks. Mr. Talbot, who is or has been connected with the Board of Examiners for the State of Oregon, convinced the audience that these exams were becoming more difficult every year and the "grandad" clause would soon be extinct.

The next paper was "Professional Development—The Importance of Early Planning" by D. W. McLenegan, Mem. ASME, specialist design engineer, General Electric Company, Richland, Wash. Mr. McLenegan pointed out that only about 25 per cent of high-school graduates enter college and about 50 per cent of these drop out before they graduate. Therefore it is important to motivate students while they are still in high school to become interested in engineering. After graduation from college comes the "First Five Years of Professional Development" which is the ECPD program. He emphasized that the engineer himself must decide upon which objectives to aim for.

John Talbot, Robert Steidel, and Harry Banfield commented orally. Dr. Steidel said that it was hard even to hold the interest of college students in engineering and he is the Faculty Adviser to the ASME Student Branch at the University of California. C. E. Davies, secretary, ASME, who had just walked into the meeting, boomed out, "What was that crack about the student branches?" Dr. Steidel replied that he had received reams of material from the ASME but that most of this material or propaganda was written in the language of high-school students rather than college students and that he was getting poor results in selling ASME to the students. Harry M. Banfield, Jr., said that he was striving to get a student branch started at the Portland State College.

The last paper, "Professional Development of the Young Engineer," was written by R. E. Curtis, personnel development specialist, General Electric Company, Richland, Wash. Mr. Curtis, being unable to attend the meeting, sublet the presentation of his paper to Rodney Shoen, specialist in training and development, General Electric Company, Richland, Wash. He outlined the Rotational Training Program carried out at the Hanford G-E plant. In this plan a young engineer fresh from school gets to try out in three or more jobs to see which he is best capable of mastering. He said that, as a rule, this was the one in which he was most interested and really enjoyed doing.

Engineers Are "Babied"

An oral discussion of this paper was pre-

Audience at Monday evening Junior-Management-Education Session during the ASME Spring Meeting held in Portland, Ore. First row, *left to right,* Robert F. Steidel, Jr., Rodney B. Shoen, Vernon R. Hill, and D. W. McLenegan.

[1] Westinghouse Electric Corp., Radio and Television Division, Metuchen, N. J.

[2] Session Chairman, Assoc. Mem. ASME, Hanford Works, General Electric Company, Richland, Wash.

[3] Assoc. Mem. ASME, Assistant Professor Engineering Design, University of California, Berkeley.

[4] University of California Radiation Laboratory, Livermore, Calif.

[5] Assoc. Mem. ASME, Tide Water Associated Oil Company, Portland, Ore.

sented by Bryan T. McMinn, Vice-President Region VII, and Fellow ASME, University of Washington, Seattle, Wash. He expressed concern over the shortage of engineers and the fact that educators all over the country were doing almost too much for the student engineers. He felt that college programs which left no choice of courses tended to cause the students to let others think for them. It was his feeling that engineers were "babied" too much at the present time.

After Professor McMinn's discussion, President Barker was called upon for any comments that he might have. The part of his talk that impressed me was his examples of offers of high engineering wages which he said appeared in New York City papers. One firm listing only a box number was offering graduate engineers with at least a master's or doctor's degree $1000 per month. President Barker said he was afraid that engineers would be getting swell-headed or too big for their "britches" if industry kept raising their wages too high.

No 1956 Freeman Award—Committee Announces

The Freeman Award Committee of The American Society of Mechanical Engineers announced that there will be no award of the Freeman Fellowship for study or research in hydraulics in 1956, inasmuch as the applications submitted did not meet the required specifications—namely, a worthy study or research program in hydraulics or related field.

ASME and the American Society of Civil Engineers are joint administrators of the Freeman Fund. The Freeman Award Committee makes awards through these societies in alternate years. In 1957 the award will be made by the ASCE.

ASME Fuels Division Seeks More and Better Papers

The Fuels Division of The American Society of Mechanical Engineers seeks more and better technical papers. William T. Reid, chairman, Program and Meetings Committee of the Division, in an open letter stated the need for a backlog of reviewed and accepted papers.

Speaking of papers presented at successful sessions in the past, he described the type of papers sought by the Division.

"These should be technical papers that are submitted to the Division by authors who have something important to say. They should be submitted because the authors *want* to present them, not because of sales efforts by a member of the Program Committee. We want engineering reports, not sales pieces. And we want outstanding papers. The same kind, in fact, that you enjoy hearing and reading."

Mr. Reid seeks papers from the men who have been "toying for years with the idea of writing a paper on a fuels problem that was particularly tough to lick, but that you solved successfully. Maybe you have some thesis work that would stand rewriting in the form of a technical paper. Possibly you've been part of a team that has accumulated important data of interest to others working on fuels problems. Or maybe you're just completing a research where publication of your results needs consideration."

Authors are assured careful and unbiased technical review of their papers and, if accepted, an opportunity for presentation. Mr. Reid and the members of the Committee would welcome suggestions. Further information may be obtained by writing W. T. Reid, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

Actions of the ASME Executive Committee

Meeting at Headquarters, April 6, 1956

A meeting of the Executive Committee of the Council of The American Society of Mechanical Engineers was held Friday, April 6, 1956, in the rooms of the Society. There were present: J. W. Barker, chairman, F. L. Bradley, F. W. Miller, A. C. Pasini, of the Executive Committee; H. J. Bauer, chairman, Finance Committee; J. L. Kopf, treasurer; W. H. Byrne, Vice-President; H. C. R. Carlson, R. B. Lea, Joseph Pope, directors; C. E. Davies, secretary; D. C. A. Bosworth and O. B. Schier, 2nd, assistant secretaries; and Ernest Hartford, consultant. Louis Polk telegraphed that owing to business commitments he was unable to attend. The following actions are of general interest:

Organization Committee

The President reported that he sent a communication to the chairmen of Boards and Committees regarding the selection of personnel for Boards and Committees; in particular, the number of nominations of nonmembers when interested and competent members are available to serve.

Board on Technology

The Executive Committee, on Feb. 3, 1956, considered the recommendation of the Board on Technology that special services be extended to Student Members and requested that estimates of expense involved be submitted. Estimates of expense were prepared and discussed at the joint meeting of the Board on Technology and the vice-presidents on Feb. 24, 1956. As a result the matter was placed in the hands of O. B. Schier, 2nd, assistant secretary. It will be discussed at forthcoming RAC meetings as a part of membership development and the entire problem of services to Student Members. This matter will be resubmitted to the Executive Committee at a later date.

Board on Education and Professional Status

Approval was voted of the revised Policy on Registration of Professional Engineers. The Secretary was asked to distribute the Policy to the Sections and to the officers of the National Society of Professional Engineers.

Research Committee

The Secretary reported the following contracts for the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals:

Southern Research Institute—Extension Agreement: Research on the Properties of Cast Iron at Elevated Temperatures cover (1) softening tests, (2) stress-rupture and creep tests, and (3) thermal-shock tests—contract effective as of Jan. 1, 1956, through Dec. 31, 1956, cost not to exceed $5000.

University of Michigan Engineering Research Institute—Contract: Preparing a correlated Compilation of Data on Strength of Weldments at High Temperatures—contract effective as of March 15, 1956, through March 15, 1957, cost not to exceed $1000.

In order to simplify procedure in contract matters, the Board of Directors of the ASTM and the Executive Committee of ASME authorized the ASME to serve as the contracting agent for contracts authorizing research for the Joint Committee.

Boiler and Pressure Vessel Committee

The Executive Committee of the Council voted to request the Boiler and Pressure Vessel Committee to prepare a definitive statement of policy on the issue of the ASME Code Symbol Stamps to foreign manufacturers.

Committee on Professional Practice of Consulting Engineering

Upon recommendation of the Committee on Professional Practice of Consulting Engineering, the Executive Committee of the Council voted to approve extending an invitation to the American Institute of Consulting Engineers to participate with the ASME and the ASCE in the Joint Committee on Manual Revision.

World Power Conference, Vienna, 1956

The Executive Committee of the Council voted to designate Glenn B. Warren and James N. Landis, Honorary Vice-Presidents, to represent the Society at the World Power Conference to be held in Vienna, Austria, June 16–23, 1956.

The Engineering Institute of Canada

It was reported that the Secretary had been elected to Honorary Membership in The Engineering Institute of Canada.

UPADI Convention

President J. W. Barker was authorized to appoint Honorary Vice-Presidents to represent the Society at the UPADI Convention to be held in Mexico City, Oct. 8–12, 1956.

Thomas L. Wilkinson

The Executive Committee noted with deep regret the death on March 27, 1956, of Thomas L. Wilkinson who served as Vice-President of the Society, 1924–1926.

Presidential Representatives

The Executive Committee noted the following appointments of presidential representatives: University of California, 25th Anniversary of Pres. Robert G. Sproul, March 23, 1956, Arthur Ingraham; Wallace Clark Award Luncheon for H. B. Maynard, April 11, 1956, H. C. R. Carlson; Marquette University, Milwaukee, Wis., Convocation, 75th Anniversary, April 16, 1956, J. F. Roberts; University of Cincinnati, 50th Anniversary of Co-Operative Education, Herman Schneider Day, April 19, 1956, R. L. Goetzenberger; American Academy of Political and Social Science, annual meeting, Philadelphia, Pa., April 20–21, 1956, T. S. Fetter, Jr., and Robert E. Derby.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Mechanical Engineer, BS basic, 33; 1 year basic steel training; one year plant layout and construction supervision; two years' chemical pilot development-research manager; also engineering management, and organization. Prefers Conn. or Mass. Me-293.

Mechanical Engineer, BSME, 31; eight years in engineering administration, supervision, design, product development, reports, material handling, production control, subcontracting, plant layout, equipment selection. Résumé available. Desires manufacturing or engineering administration. Me-294.

Engineering Executive, 27 years of most extensive plant-engineering experience. Energetic, initiative, and with proved ability to organize, direct, and control. Graduate, registered mechanical engineer. Presently employed. Prefers Eastern area. Me-295.

Positions Available

Sales and Application Engineer, 28–40, mechanical or electrical graduate, air-borne instruments' experience, to sell transducers, gyro instruments, data computers, and air-data-control systems. $7500–$10,000, plus sales incentive. New York, N. Y., and Chicago, Ill. W-3091.

Editor, 30–35, mechanical-engineering graduate, technical writing and machine-design experience in electrical and electronic fields. $7500–$8500. New York, N. Y. W-3094.

Mechanical Engineer, graduate, 28–35, five to ten years' experience in steam and power generation, for industrial power-plant system. N. C. W-3107.

Assistant Director of Industrial Relations, engineering graduate, process industry and equipment experience including personnel and technical recruiting. Some traveling. $7000–$8000. Eastern Pa. W-3113.

[1] All men listed hold some form of ASME membership.

Teaching Personnel. (*a*) Assistant professor, MS in mechanical engineering, to teach heat-power courses. Will do consulting or research for extra compensation. (*b*) Assistant professor, MS in industrial engineering, to teach industrial-engineering courses and engineering economy. Will do consulting or research for extra compensation. Positions available September, 1956. $5500–$6000 for nine months. South. W-3116.

Plant-Layout Engineer, mechanical or electrical, 32–35. Will be responsible for making up of layout and board work. Will be required to do some of the board work as he will be working with group leaders and will be in charge of maintenance and millwright division. Will report to executive vice-president or chief manufacturing engineer. Foundry has been moved from the central location to new site; will have to re-layout the whole machine shop and assembly department. Must know material-handling equipment, hydraulic systems, electrical conduits, etc. Company will pay moving expenses and negotiate fee. $6000–$8400. Ohio. W-3122(*b*).

Project Engineer, 28–40, mechanical or electrical graduate, design and product-engineering experience on temperature-control mechanisms, including thermostats, small circuit breakers, overload relays, or protective devices. $12,000–$14,000. Northern N. J. W-3137.

Process Engineer to supervise process department of company that fabricates and finishes metal parts and assemblies. Should have at least five years' experience and be able to present new ideas regarding processing of products through plant. May supervise time and motion study and estimating departments at a later date. $7200–$7800. Midwest. W-3140.

Industrial Engineer to head up a research group in analyzing time and motion-picture films, micromotion studies, etc., for industrial-management consultants. Little travel. $8000–$10,000. New York, N. Y. W-3148.

Teaching Personnel. (*a*) Mechanical engineer, at least BS degree, to teach engineering drawing and possibly descriptive geometry. (*b*) Mechanical engineer, at least a BS, to teach heat power and possibly internal-combustion engines and steam. Salaries open, depending upon background and education. Pa. W-3153.

Assistant Plant Engineer, graduate mechanical, to 30, at least four years' experience in small precision castings. Work will be in connection with building of equipment and maintenance of all building equipment and will be in charge of maintenance department. $6000–$7000. N. J. W-3154.

Plant Engineer, at least ten years' experience in plant layout, construction and maintenance of cement mill and open-pit quarry. $8000–$10,000. Eastern Pa. W-3159.

Director of Industrial Relations, 35–45, for multimanufacturing-plant operations. Must have knowledge of standard labor practices and some previous experience in negotiating labor contracts. $20,000. Midwest. W-3173.

Production Manager, 40–50, engineering training and at least ten years' design, production, and management experience covering valves, pumps, steel and grey-iron castings and accessories. $10,000–$15,000, plus bonus. Calif. W-3175.

Engineering Supervisor, mechanical or electrical graduate, at least five years' supervisory experience covering design and installation of heating plants, lighting and power installations, and service utilities. $10,000. Newfoundland. W-3176.

Chief Manufacturing Engineer, 35–45, considerable experience in the manufacture of industrial filters such as auto-aircraft, etc. $15,000–$20,000. 50-mile radius of New York, N. Y. W-3182.

Production Manager, 30–45, good background in industrial-engineering standards, quality control, etc., in the needle and sewing trades. $12,000. New York, N. Y. W-3183.

Manager of Quality Control and Inspection, a complete knowledge of statistical quality-control and inspection methods; experienced in small components and thoroughly familiar with metal-working processes; knowledge of and experience with Air Force quality-control regulations and matters such as the MRB procedure and Military Standard 105. $7500–$10,000. Pa. W-3185.

Manufacturing Engineering Manager for manufacturer of precision metal parts, 33–45, with mechanical or industrial-engineering degree. Must have good background in tooling. Will report to vice-president in charge of production. Will be in charge of staff of about 50 people which will include chief industrial engineer and chief production engineer. Also will be responsible for administration, tool and equipment design, engineering activities, and co-ordination of plant engineering. $12,000–$20,000. East. W-3187.

Assistant or Associate Professor, PhD in mechanical engineering, a thermodynamics or heat-power background. Position starts September, 1956. Salary open. New York metropolitan area. W-3189.

Engineers. (*a*) Senior industrial-relations representative, 30–40, degree in Business Administration, Law, Industrial Psychology, three to five years' experience in any of the industrial-relations fields, some employee and labor-relations experience in a medium or large-sized plant. (*b*) Industrial-relations representative, 23–42, degree in Business Administration, Law, Industrial Psychology, and two to four years' experience in any of the industrial-relations fields, some employee and labor-relations experience in a plant. Salaries open. Southern United States. W-3190.

Senior Industrial Engineer, 27–36, graduate, minimum of five years' experience in methods, standards, layout, cost, and time study. Heavy industrial experience desirable. Salary open. W. Va. W-3191.

Engineers. (*a*) Chief engineer, 35–45, ten years' experience in sheet-metal tooling appliance and air conditioning, to supervise plant engineering, plant layout, manufacturing improvements, methods, production planning, and processing; tools, dies and fixture design; special machinery design; packaging design; time and motion study and production standards. Some travel; applicant must have car. $10,000. (*b*) Tool and Die Designer, minimum of three years in actual design, experience on sheet metal and air conditioning. Will design tools, dies, fixtures, gages, etc.; specify materials and treatment of materials for tools, dies, jigs, fixtures, etc.; make dimensioned drawings as required for tools, dies, jigs, fixtures, etc. Very little travel; car required. $6700. Central Pa. W-3193.

Industrial Engineer, graduate, about 30, experience in food processing, pharmaceutical, or closely related industries and two to four years' work in cost and material control; should be interested in and capable of assuming the responsibilities of one of several management positions. Some travel and willing to relocate in either N. Y., Pa., Mich., Ark., or Wash. $8000. W-3194.

Assistant Plant Engineer, mechanical graduate, four to six years' construction, plant-engineering, and maintenance experience in organic-chemical manufacturing. $7000. N. J. W-3197.

Mechanical Engineer, graduate, fully experienced on machinery and tool designing, background in small precision stampings and automatic screw machines. Salary open. Northern N. J. W-3200.

Chief Industrial Engineer, mechanical or industrial graduate, supervisory time study, methods, incentive and cost-reduction experience covering cutting and sewing operations in texile fields. Some traveling. $8000–$10,000. N. J. W-3203.

Chief Inspector, mechanical, experience in power and heating-plant work to inspect the installation of turbine and heating equipment on a project in Canada; 35–65. Applicant must be an American citizen; will spend a year out of the country. $8000–$12,000. W-3222.

Production Engineer, mechanical or industrial, 22–50, one year's experience in production of high-volume lines. Knowledge of production methods. Will be factory engineer on production of electromechanical control devices. $6000–$9000. Employer will negotiate fee. Ill. C-4732.

Lubrication Engineer, mechanical graduate, 32–38, at least three years' experience with machinery and machine-shop operations. Will act as consultant to sales department on industrial lubrication problems. Will also advise industrials in general on lubrication systems and products. A little travel. Car required. Company is a refiner of petroleum. $7800. Employer will negotiate fee. Chicago, Ill. C-4754.

Chief Industrial Engineer, mechanical or industrial, 30–40, five years' experience, heavy on tooling. Knowledge of incentives, time studies, machine shop. Duties will include supervision of 15 men in department responsible for incentives, time study, equipment purchase, and tool design. Heavy-equipment nonboring mills, turret, lathes, engine lathes, etc. Rare traveling. For heavy-equipment drills, compressors, oxygen, generators. $7500–$10,000. Employer will pay fee. Ind. C-4763.

Plant Engineer, mechanical or electrical graduate, to 35, at least one year's experience in plant engineering in food processing. Duties will include plant-engineering projects, equipment studies and recommendations, buildings, installations, some equipment design, power methods, and maintenance. $6000–$7800. Employer will pay fee. Chicago, Ill. C-4816.

Sales Engineer, degree in mechanical engineering or physics, 35–55, at least five years' experience in optical-tooling field, jigs and fixtures, or surveying equipment. Will do sales-engineering work for optical-tooling equipment to industry in general. Home week ends. $8000–$10,000, plus expenses. Employer will pay fee. Territory, East Coast. C-4849.

Senior Research Engineer, Mechanics Division, PhD in mechanical engineering, 30–45, ten years' experience in research and development in terminallistics, aerodynamics, servomechanisms, theoretical mechanics, inertial guidance, aircraft structures, or missiles. Knowledge of applied-research techniques. Will supervise engineers on applied mechanical research projects. Will be encouraged to teach part time at graduate or undergraduate level and develop ideas for sponsorship. Limited travel. $7500–$10,200. Employer will negotiate fee. Colo. C-4853.

Plant Superintendent, mechanical graduate, to 40, at least three years' experience supervising job-shop work on stampings, press work, and metal finishing and assembly. Will supervise all production for small company handling press work, stampings, plating, and some job-shop assembly work. $10,000–$12,000. Employer will pay fee. Chicago, Ill., suburb. C-4857.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after May 25, 1956, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and ●Transfers

Alabama

ROWE, ALVAH L., JR., Decatur

Arkansas

DEAVER, FRANKLIN K., Springdale

California

BALL, HARRY N., Downey
CHOWN, WILLIAM H., Los Angeles
EDWARDS, HUGH T., JR., Whittier
HADGES, D. GEORGE, Rosemead
● HARNEY, DORAN B., Compton
HARTLINE, WILLIAM R., Los Angeles
KUBEREY, ROBERT, JR., San Diego
MCGEE, WILLIAM S., JR., Long Beach
MCMAHAN, HAROLD C., Arcadia
MONDAY, JOHN L., Sunnyvale
MOORE, ROBERT I., North Hollywood
MURPHY, BRADFORD D., Los Angeles
PETERSON, CARL A., JR., Los Angeles
SCHAETZEL, ROBERT A., Woodland Hills
SHACKLETON, JOHN A., Napa
WEBER, ERWIN F., Sherman Oaks

Colorado

FOX, ROBERT W., Boulder
MERRILL, MARCELLUS S., Denver

Connecticut

ALTIZER, RINER G., Stamford
POMON, EDMUND S., Bristol
SAWERT, WALTER, Branford
SMITH, LAWRENCE E., Waterbury

● Transfer to Member or Affiliate.

THOMSON, ALEXANDER L., Hartford
VAN RAAPHORST, CHRIS F., Milford

Delaware

DAVIS, ROBERT W., JR., Wilmington
● NUSBAUMER, JOSEPH A., JR., Seaford

District of Columbia

SMITH, MAX T., JR., Washington

Florida

BRIER, DANIEL L., Vero Beach

Georgia

BATTENFIELD, ALVA L., Atlanta
HOLLAND, WILLIAM C., Decatur
MOORE, HENRY C., JR., Atlanta

Illinois

ANGST, JOHN E., Chicago
CORDUAN, ERNST A., Morton Grove
FRANCIS, WILBUR M., Decatur
FRANK, RICHARD S., Peoria
FREY, KURT P. H., Chicago
GOLBECK, BERNARD J., Crystal Lake
LEE, BYRON O., JR., Chicago
LOWRY, WILLIAM L., Chicago
MOORE, DAVID H., Chicago
REDMAN, DAVID F., Chicago
RUSSELL, WILLIAM B., Kewanee
WHITNEY, WILLIAM G., Cicero

Indiana

HARVEY, DONALD A., Evansville
MCALISTER, LAWRENCE S., JR., Fort Wayne

Iowa

STEVENSON, DANIEL B., JR., Des Moines

Kansas

CURRY, GEORGE L., Overland Park

Kentucky

KREIDER, CHARLES M., Anchorage

Louisiana

HARRIS, DEATON T., Port Sulphur
MCLEAN, JOE L., JR., New Orleans

Maine

● JENKINS, DONALD R., Orono

Maryland

ENY, DESIRE M., Army Chemical Center
● FAWCETT, JAMES F., Catonsville
PADDISON, FLETCHER C., Bethesda
STOMBLER, EUGENE H., Baltimore
WILLIS, ALVIN H., Glen Burnie

Massachusetts

BOWLER, JOHN A., Belmont
CANNON, MADISON M., South Walpole
MCCORMICK, WILLIAM A., JR., Boston
MONDANO, RALPH L., Cambridge
MONKMAN, FOREST C., South Boston

Michigan

ABRAHAMSON, KENNETH H., Detroit
MCCAIG, PAUL S., Royal Lake
MOLNAR, MARTIN A., Sanford
● PHELPS, VERNON A., Ann Arbor

Missouri

BRIDGES, RONALD P., Centralia
CRUMP, JAMES S., St. Louis
KERNAN, CHARLES R., JR., St. Louis
LENTZ, CHARLES L., Kansas City

New Jersey

CUNNEEN, RICHARD H., Ridgewood
NEWMAN, ERNEST G., Hoboken

New York

BENSON, FRANCIS P., JR., New York
BIRD, DONALD F., Hempstead
CASHIN, JOHN T., JR., Bronx
DAVIS, CHARLES E., Franklin Square
DESAI, CHHOTUBHAI R., Pearl River
FRANKLIN, BEN, New Hyde Park
HADJIYANNAKIS, DEMOSTHENES C., New York
KLUZAK, JAMES, Ballston Spa
LABDON, ROBERT A., Huntington
● LEDGERWOOD, BYRON K., Brooklyn
LETO, JOSEPH E., Rochester
● LOIACONO, ANTHONY J., Yonkers
LOOMIS, CECIL E., New York
MCKEON, JAMES T., New York
MCNERNEY, HENRY F., New York
SOMIADES, NICHOLAS, New York
STURLEY, RICHARD A., Kirkville
YAW, EDWIN C., Baldwin

North Carolina

JOHNSON, WILLIAM E., Grifton

Ohio

● ANDERSON, GEORGE W., Canton
BANNER, CHARLES E., Toledo
● BLUESTEIN, PAUL H., Cincinnati
CARLSON, ROBERT L., Worthington
DEHAVEN, WILLIAM K., Akron
FESLER, JAMES C., Alliance
● GREENBERG, RALPH, Mayfield Heights
KEINATH, WILLIAM J., Cincinnati
LAWLOR, PATRICK J., Alliance
MEEHAN, JOSEPH C., Alliance
PAUS, JOHN R., Fostoria
RACKLEY, JOHN M. Alliance
SALMASSY, OMAR K., Columbus
SEDOR, PAUL, Alliance
SMITHYMAN, ROBERT C., Sebring
TAUSCHEK, MAX J., Cleveland
● WOOD, JOHN B., Cincinnati

Oregon

LARSON, MILTON B., Corvallis

Pennsylvania

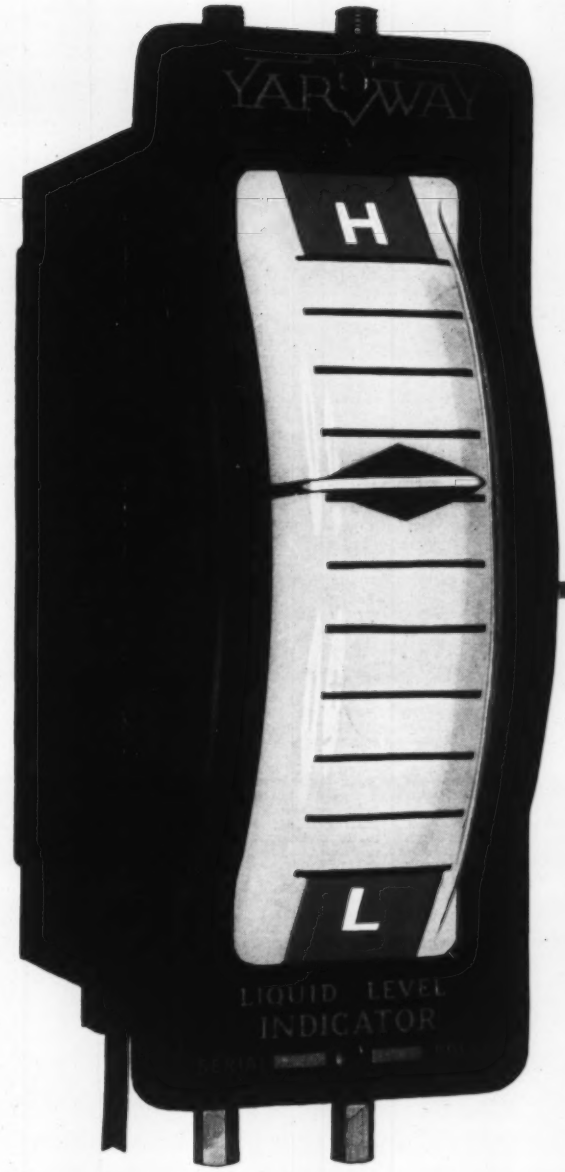
AXELSON, FREDERICK R., State College
FLECKENSTEIN, HAROLD F., Philadelphia
HARDGRAVE, ROBERT L., Rosyln
LEWE, ROBERT H., Yardley
MATERA, TED A., Pittsburgh
MILLER, JOSEPH A., Pittsburgh
MOORE, CHARLES F., York
SANSONE, LEONARD P., JR., Pittsburgh
SWITZER, GEORGE W., JR., Reading
WEBB, G. ARTHUR, Pittsburgh

Rhode Island

HAND, LOUIS J., Providence
RIBACK, ARNOLD O., Providence

(ASME News continued on page 500)

this is "life insurance" for boilers



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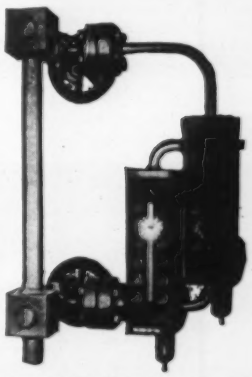

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PALMER, LOUIS C., Camden
YANKOGLU, NIKO K., Camden

Tennessee

AUTH, ROBERT V., Knoxville

Texas

KUNZ, JOHN E., Houston
PERET, JOHN W., Dallas
TURNER, ALEXANDER J., Lubbock

Virginia

RODDIS, LOUIS H., JR., Falls Church

Washington

AUNE, TORLEIF J., Spokane
JESSEN, RAYMOND T., SR., Richland
MARTIN, WILLIAM D., Richland
SIROLA, MILTON J., Benton City
• SWANN, JAMES P., Spokane
VICKREY, CHARLES S., Longview

West Virginia

DLUGOS, JOHN J., JR., St. Albans
HAGLEY, RALPH C., Huntington
KAHLER, WILLIAM G., South Charleston
MCCOLGAN, WILLIAM W., Belle
MERRITT, RALPH T., Charlton Heights
SAMPSON, WILLIAM F., Malden
VELLINES, WESLEY E., Charleston

Wisconsin

CHARLIN, JORGE, South Milwaukee
• FLEMING, ROBERT W., Madison
JOHNSTON, ROY C., Milwaukee
KRAUSE, CLARENCE H., Milwaukee
PFEIFFER, LESTER G., Milwaukee
SMITH, LOWELL M., Two Rivers
• TIMMCKE, MERLE E., Beloit

Foreign

DEBREET, CORNELIS J. J., Demerara, British Guiana, S.A.
• DEDIALLA, JAI S., Khargpur, India
FRYER, COLIN J., Honolulu, T. H.
GARCIA-MUINO, MANUEL J., Camaguey, Cuba
GOLD, HANS, Risley, Lancashire, England
HARVEY, THOMAS J., Corunna, Ont., Can.
JULSKJAER, VAGN, Aarhus, Denmark
MELESE, GILBERT B., Servres (S&O), France
RAO, KULLAJI G. K., Jamshedpur, India
WARD, PHILIP L., Guelph, Ont., Can.

Transfers from Student Member to Associate Member..... 62

Obituaries

Arthur Smith Benton (1900–1956), manager, Atlanta (Ga.) Division, Westinghouse Air Brake Co., died Jan. 15, 1956. Born, Fordsville, Ky., Nov. 8, 1900. Education, BSME, Purdue University, 1923. Mem. ASME, 1946. Author of papers presented before professional societies. Survived by wife; three daughters, Gail (Olympic swimming contender), Mrs. Jack G. Peltier, and Mrs. Frank A. Holder, Jr.; two sons, Arthur S. and Don Carlos, 3rd, all of Atlanta; and three sisters, Mrs. Grace Caswell, Mrs. Virgil Speare, and Mrs. Fred Hauck; and a brother, Don Carlos Benton, all of Louisville, Ky.

Henry Burke (1907–1956?), project manager Kaiser Industries Division, Kaiser Engineers, Inc., Oakland, Calif., died recently, according to a notice sent to the Society. Born, Lawrence, Mass., Jan. 31, 1907. Education BS(ME), Norwich University, 1924. Mem. ASME, 1945. Author of several technical papers and held patents pertaining to pipe packing, tunnel lining, and time fuze.

William Howard Burton (1888–1955), chief engineer and superintendent, Central Maine Power Co., Wiscasset, Maine, died Aug. 27, 1955. Born, Barbados, B. W. I., Nov. 16, 1888. Education, graduate Harrison College, 1905; Electrical-engineering courses, Brown University, 1925–1930. Mem. ASME, 1952.

Joseph William Buscher (1932–1954), Corps of Engineers, USA, was killed in the service, Nov. 22, 1954. Born, Terre Haute, Ind., April 7, 1932. Education, BS(ME), Rose Polytechnic Institute, 1954. Assoc. Mem. ASME, 1954.

Philip Grosvenor Corin (1897–1955), vice-chairman and joint managing director, Henry Berry & Co., Ltd., Croydon Works, Hunslet, Leeds, England, died Oct. 14, 1955. Born, Poldsworthy, Devon, England, Aug. 14, 1897. Education, graduate, Shebbear College, North Devon, England; MA in mechanical sciences, Cambridge University, 1922. Mem. ASME, 1954. Author of technical papers and held patents on high-pressure hydraulic technique and machine tools.

Henry Middlebrook Crane (1874–1956), special consultant on engineering matters for General Motors Corp., died Jan. 21, 1956. Born, New York, N. Y., June 16, 1874. Education, attended Phillips Exeter Academy; ME, Massachusetts Institute of Technology, 1895; EE, 1896. Mem. ASME, 1920. Survived by a brother, Clinton H. Crane.

James Eggleston Davenport (1887–1956), who retired as a vice-president of the American Locomotive Co. in 1946, died Jan. 24, 1956. Born Charleston, W. Va., Oct. 8, 1887. Education, BS(ME), Georgia School of Technology, 1908; BS(EE), 1909. Mem. ASME, 1939. He was a former president of the International Railway Fuel Association and a director of the Steam Locomotive Research Institute. Survived by three brothers, Frank, Atlanta, Ga.; Henry, Roanoke, Va.; and Robert, Christianburg, Va.

William Yeats Duncan (1890–1955), retired Captain, USN, died Dec. 12, 1955. Born, Overbrook, Pa., Dec. 17, 1890. Education, graduate, class of 1910, Williamson College. Assoc-Mem. ASME, 1921; Mem. ASME, 1926.

Eric Hanover Garrett (1892–1956), retired general manager, Kendrick and Davis Co., Lebanon, N. H., died Jan. 9, 1956, at his home in Hollywood Beach, Fla. Born, Kingston, Jamaica, B. W. I., Jan. 13, 1892. Parents, Theophilus C. and Clara C. (Murphy) Garrett. Education, Jamaica College, 1903–1910; BS(ME) McGill University, Montreal, P. Q., Can., 1914. Naturalized U.S. citizen, Woodside, N. H., 1927. Married Dorothy Irene Dunn, 1916; son, Robert R. Mem. ASME, 1927; Fellow ASME, 1952. He served the Society as chairman, Green Mountain Section, for two years.

Frank C. Hockema (1892–1956), vice-president, Purdue University, died Feb. 3, 1956, in Home Hospital, Lafayette, Ind., of a heart ailment. He had been vice-president since 1944. He also was executive dean and had been secretary of the board of trustees since 1935. Born, Shadeland, Ind., March 25, 1892. Parents, Henry T. and Elizabeth (Bush) Hockema. Education, graduate, Indiana State Teachers College, 1913; BS(ME), Purdue, 1918; MS(ME), 1923; PhD, Indiana University, 1948. Married Martha Kuipers; children Max. W., Thomas K., David F. Assoc-Mem. ASME, 1922; Mem. ASME, 1929; Fellow ASME, 1948. Author numerous articles on industrial management, education, salesmanship, and accounting; series of approximately 400 briefs for industrial managers. Recipient of a grant-in-aid from the Carnegie Corp. of New York for contribution to current studies on education with emphasis on engineering, 1940. Held membership in professional, educational, civic, and honorary societies. Survived by wife and three sons.

John Edward Jones (1903–1955), senior designer, mechanical-engineering division, Corning Glass Works, Corning, N. Y., died July 30, 1955. Born Kemptville, Ont., Can., May 1, 1903. Education, graduate, Frankfort (Mich.) High School, 1921; BS(ME), University of Michigan, 1931. Mem. ASME, 1954.

Maitland MacLehose (1895–1955), sales engineer, The Berwind-White Coal Mining Co., New York, N. Y., died Oct. 22, 1955. Born, East Orange, N. J., Dec. 19, 1895. Parents, Leonard F. and Marion (Burgess) MacLehose. Education, graduate, East Orange High School; attended Cooper Union General Science (Night) courses, three years. Married Whynama Benson, 1930. Assoc-Mem. ASME, 1927; Mem. ASME, 1935. Survived by wife and a daughter, Mrs. Elizabeth M. Parker, Arlington, Va.

Hector Martínez-D'Meza (1905–1955), general manager of operations, Comision Federal de Electricidad, Mexico City, Mex., died Dec. 25, 1955. Born, Mexico City, Nov. 27, 1905. Parents, Gustavo S. Martínez and Josefina D'Meza Vda.deMartinez. Education, ME and EE, National University of Mexico, 1930. Married Eva Silva, 1936. Mem. ASME, 1955. From 1931 to 1936 he was in the service of the Mexican Government, active in developing legislation dealing with the electric development of Mexico and in the creation of the Federal Electric Commission, a Government agency concerned with the general electrification of the country. He entered the service of the Federal Electric Commission in 1937 and was named vice-president of the Commission in 1942. He was acting simultaneously as consultant for the Government bank of issue on matters of industrial development in Mexico until 1946, when for reasons of health he resigned from all activities. In 1947 he was named Counsellor of the Mexican Embassy in Washington, D. C., and from 1949 to 1951 he served as Mexican Consul General in Germany. Upon his return to Mexico he was named assistant general manager of Industria Eléctrica Mexicana (the largest electrical manufacturing concern of the country, licensee of Westinghouse). He returned to the Federal Electric Commission in 1953 as general manager of operations and remained in that position until his death from a heart attack. He always was active in various engineering societies, both Mexican and foreign. At the time of his death he was chairman of the AIEE Mexico Section. Survived by wife and three children, Eugenia, Cecilia, and Hector, all of Mexico City.

Arthur Glenn McKee (1871–1956), chairman of the advisory board of the engineering and construction company bearing his name, died Feb. 19, 1956, at his home in Cleveland, Ohio. Born, State College, Pa., Jan. 12, 1871. Parents, Prof. James Y. and Margaret Anne (Glenn) McKee. Education, BS, Pennsylvania State College, 1891; ME, 1899; Hon. DE, Case School of Applied Science, 1941. Married Marion Fairbanks Deane, 1899 (died 1948); children, Mary K. (Mrs. Paul O.) Semon, Jr., and Marion D. (Mrs. John) Latta (died 1951). Married 2nd Bennetta Heath Alexander, 1950. Mem. ASME, 1907; Fellow ASME, 1943. He was noted for his designs of blast furnaces, steel mills, and oil refineries. The Arthur G. McKee Co. completed more than 2500 projects, valued at more than a billion dollars, in 42 countries. Under his direction the company built plants in China, Canada, and Mexico, among other countries. In 1932 the company was credited with construction of the "Gary of Russia," a huge steel-making center at Magnitogorsk. The company built the first steel plant in Brazil. He was the inventor of the KcKee distributor which is used universally in blast-furnace operations and the author of numerous technical papers published in professional journals.

Fred A. Miller (1898–1955), materials-handling consultant, engineering department, E. I. du Pont de Nemours & Co., Inc., died Nov. 21, 1955, at his home in Wilmington, Del. Born, New York, N. Y., Aug. 16, 1898. Education, graduate, Newtown High School, New York, N. Y., 1918; attended University of Toronto and New York University; took ICS courses in structural design. Mem. ASME, 1950. He was a member of American Material Handling Society and recipient of its 1954 National Certificate of Merit. He was also a member of Delaware Society of Professional Engineers. Holder of numerous patents in the materials-handling field, including bulk-shipping container and stacker crane; author of articles published in many technical periodicals. Survived by wife and one daughter.

Moyes Joseph Murphy (1894–1955), president of company bearing his name, died May 5, 1955, at his home in Arcadia, Calif. Born, San Francisco, Calif., Aug. 14, 1894. Education, Hitchcock Military Academy, 1908; Cogswell Polytechnical College, 1912; special course, Drews' School, 1915. Author of book on "Diesel Engines" and several published papers on the subject. Held patents pertaining to oil engines, fuel-injection apparatus for diesel engines, governors, gear transmissions, gasoline engines, fuel-combustion systems, hydraulic equipment, tractors, hydraulic-steering mechanisms, and torpedoes. Mem. ASME, 1945.

Henry Schreck (1880–1956), retired mechanical engineer who was a leading designer of diesel engines, died Jan. 29, 1956, in Lenox Hill Hospital, New York, N. Y. Born, Hamburg, Germany, Oct. 28, 1880. Parents, J. H. and Johanna Schreck. Education, studied marine engineering and naval architecture for two years in Dortmund, Germany, and two years in the Royal Academy of Berlin-Charlottenburg where he received an ME degree in 1905. Naturalized U. S. citizen, New York, N. Y., Jan. 20, 1920. Married 2nd, Margaret Travers, 1924. Mem. ASME, 1914. He was scheduled to receive a

(ASME News continued on page 502)

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special citation for outstanding service in the field of oil and gas-power engineering from the ASME Oil and Gas Power Division at its annual conference in New Orleans, La., on April 4, 1956. In 1946, while in the employ of the American Locomotive Co., now Alco Products, Inc., Schenectady, N. Y., he took an important part in developing the company's widely used 12-cylinder, 1600-hp locomotive diesel engine. The first of these locomotives pulled the Freedom Train which toured the United States in 1947 to pick up food and clothing donations for the needy of war-torn Europe. Survived by wife, a daughter by a former marriage, Mrs. Heidi Nowack of Germany, and a grandchild.

Blake Ragsdale Van Leer (1893–1956), president of the Georgia Institute of Technology since 1944, fifth president of the Institute since its establishment in 1885, and the first engineer to hold this office, and retired United States Army colonel, died Jan. 23, 1956, at the Atlanta (Ga.) Veterans Hospital. Born, Mangum, Texas (now Oklahoma), Aug. 16, 1893. Parents, Maurice L. and Mary (Tarleton) Van Leer. Education, BS(EE), Purdue University, 1915; ME, 1922; MS(ME), University of California, 1920; attended University of Caen, France, February-June, 1919; University of Munich, Germany, 1927–1928; hon. DS, Washington and Jefferson University, 1943; hon. DE, Purdue University, 1944. Married Ella Wall, 1924; children, Blake Wayne, Maryly (Mrs. Jordan Brown) Peck, and Samuel Wall. Jun. ASME, 1920; Mem. ASME, 1925; Fellow ASME, 1951. Awarded Freeman traveling scholarship for study of hydraulics in Europe by ASME, 1927–1928. Served the Society as Regional Delegate in 1933; on the Nominating Committee in 1935; and as a member, later chairman, of the Hydraulics Division. He served in both world wars as an officer, commissioned a lieutenant and rose to the colonelcy during the second world war; he was attached to the Corps of Engineers, USA. Recipient of Croix de Guerre bestowed by France. Following World War II he maintained his activity in the Army Reserves; he served as commanding officer of the 3107 Research and Development Unit in Atlanta and of the 401st Engineer Brigade (Reserve). In 1950 he was appointed chairman of the Defense Department special committee to select a site for the $11 million USA Quartermaster Research and Development Laboratory. He had held many important government posts. These included Florida representative of the United States Coast and Geodetic Survey; water consultant of the National Resources Commission; and from 1945 to 1949, member of the United States Commission for the United Nations Educational, Scientific, and Cultural Organization (UNESCO). He was made an honorary member of the Georgia Engineering Society in 1949. He was the author of numerous technical papers and reports. He held membership in the leading professional societies; from 1928 to 1931 he served in Washington, D. C., as assistant secretary of the American Engineering Council; in the American Society for Engineering Education he was a member of council, 1933–1936, and president of the southeastern section, 1939–1940. He was vice-president of the Florida Engineering Society, 1937–1938. He was a member of the honorary engineering and scientific societies. Survived by wife, three children, and five grandchildren.

Harry Stuart Vincent (1869–1956), retired consulting engineer in railway engineering, died Jan. 18, 1956. Born, Travilah, Md., Sept. 23, 1869. Parents, Thomas W. and Annie E. Vincent. Education, graduate, Andrew Small Academy, Darnestown, Md.; Maryland Institute, Baltimore, Md. Married Rebecca H. Chase; children, Rebecca N. and Helen P. Mem. ASME, 1921. Held more than 25 patents on devices and systems pertaining to locomotives. Author of several technical papers and reports on railway engineering.

John Morgan Wood (1895–1956), owner, Albany Hardware Speciality Manufacturing Co., Albany, Wis., died Jan. 18, 1956. Born Albany, Wis., Feb. 15, 1895. Parents, Joshua W. and Hettie M. (Morgan) Wood. Education, BSME, University of Wisconsin, 1917. Married Beth Ellen Williams, 1934. Jun. ASME, 1917; Assoc-Mem. ASME, 1922; Mem. ASME, 1927. Held several patents including a special heavy-duty lathe dog and a bonus-calculation machine for Parkhurst Bonus System.

Robert Wosak (1899–1956), chief laboratory engineer, Electric Boat Division, General Dynamics Corp., Groton, Conn., died Jan. 21, 1956, at Lawrence Memorial Hospital. Born, Munich, Germany, May 16, 1899. Parents, Robert and Barbara (Schanderl) Wosak. Education, high-school graduate, Vienna, Austria, 1914; Municipal Trade School, 1917; State Industrial School, 1919; attended evening school at Drexel Technical Institute, Philadelphia, Pa., received diploma in mechanical engineering, 1933. Naturalized U. S. citizen, Philadelphia, Pa., Nov. 11, 1932. Married Mary Estella Lilley, 1935. Mem. ASME, 1939. Served the Society at various times, as chairman, secretary, and program chairman of his Section. Survived by wife; two sons, Gordon S. and Newton R.; a daughter, Carol S.; two brothers, Dr. Walter Wosak, Vienna, and Dr. Ludwig Wosak, Salzburg, Austria; and two sisters, Dr. Maria Wosak, Vienna, and Mrs. Betty Irmler, Steiermark, Austria.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

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☐ *Applied Mechanics Reviews*	1st of preceding month

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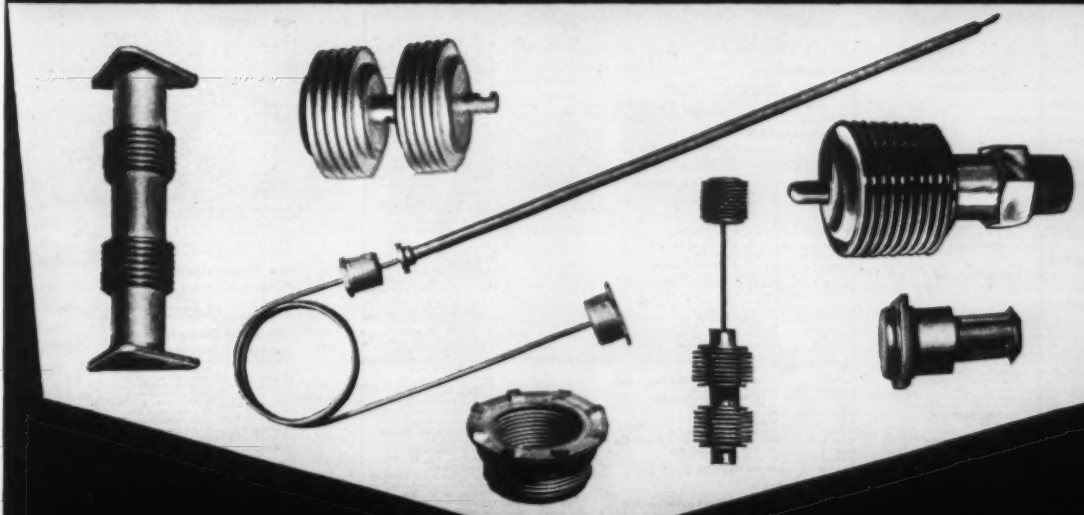

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Denver — Hendrie & Bolthoff Company
Pueblo — N. O. Nelson Co.

CONNECTICUT
Bridgeport — Lewin & Sons, Inc.
The Wallingford-Kincaid Co.
Danbury — Winfield S. Holman, Inc.
The Nutmeg Plumbing Supply Co.
Greenwich — Futty & Company, Inc.
Hartford — The Callahan Company
Lasher Supply Co., Inc.
The Plimpton & Mills Corporation
Thomas Trant & Bro., Inc.
Ward & Housser
New Britain — New Britain Plumbing Supply Co.
New Haven — The C. S. Mersick & Company
New London — Hansen Supply Co.
Norwalk — County Supply, Inc.
Norwich — The Anderson Supply Company
Putnam — Bawley Plumbing Supply, Inc.
Stamford — Connecticut Plumbing Supply Co.
Glauber, Inc.
Waterbury — M. J. Daly & Sons, Inc.

DISTRICT OF COLUMBIA
Washington — Thos. Somerville Company

FLORIDA
Fort Lauderdale — Duncan-Edward Company
Jacksonville — Farquhar Machinery Co.
Noland Company, Inc.
Miami — Bailey-Milam, Inc.
Orlando — Hughes Supply Inc.
Pensacola — May Supply Co.
St. Petersburg — Gulf Coast Industrial Supply Co.
Tallahassee — Morbut Company
Tampa — Noland Company, Inc.

GEORGIA
Albany — Georgia Hardware & Supply Co.
Atlanta — Beck & Gregg Hardware Co.
Fulton Supply Company
Grinnell Company, Inc.
Noland Company, Inc.
J. M. Tull Metal & Supply Co.
Augusta — Noland Company, Inc.
Richmond Supply Co.
Brunswick — Morbut Company
Columbus — Columbus Plumbing, Heating & Mill Supply Co.
Hajoca Corporation
LaGrange — Industrial Suppliers, Inc.
Macon — Morbut Company
Noland Company, Inc.
Taylor Iron Works & Supply Co.
Marietta — Noland Company, Inc.
Rome — Battey Machinery Co.
Valdosta — Morbut Company
Whitehead Hardware Co.

IDAHO
Boise — Idaho Industrial Supply Co.

ILLINOIS
Bloomington — Wilkins Bloomington Co.
Chicago — Chicago Tube & Iron Company
James B. Clow & Sons
Great Lakes Supply Corporation
Fred C. Kramer Co.
Miller Supply Company
Danville — Inland Supply Company
DuQuoin — DuQuoin Iron & Supply Co.
Peoria — Wilkins Pipe & Supply Company
Rock Island — American Rad. & Std. Sanitary Corp.
Rockford — D & F Supply Company

INDIANA
Anderson — May Supply Company
Aurora — Aurora Supply Company
Evansville — Plumbers Supply Corporation
Fort Wayne — The National Mill Supply Company
Indianapolis — Plumbers Supply Corporation
Kokomo — The Main Supply Company
Lafayette — Biggs Pump & Supply Co.
Marion — Liniger Company
Richmond — H. R. Smith Supply Co., Inc.
South Bend — The South Bend Supply Company
Terre Haute — Mechanical Suppliers, Inc.

IOWA
Cedar Rapids — Cedar Rapids Pump & Supply Co.
Des Moines — A. Y. McDonald Mfg. Co.
Plumb Supply Co.
Dubuque — A. Y. McDonald Mfg. Co.
Marshalltown — Glick Supply Company
Sioux City — Wigman Company
Waterloo — Winterbottom Supply Co.

KANSAS
Wichita — Phillip & Easton Supply Co.

KENTUCKY
Hopkinsville — Coyce Mill Supply Company
Lexington — Plumbers Supply Company
Louisville — Beltnap Hdwe. & Mfg. Co.
Neill-LaVielle Supply Company
Plumbers Supply Company

LOUISIANA
Monroe — Murco, Inc.
New Orleans — Edgar Murray Supply Co.
Shreveport — Monsco Supply Co.

MAINE
Bangor — R. B. Dunning & Co.
Portland — W. L. Blake & Co.

MARYLAND
Annapolis — Thos. Somerville Company
Baltimore — The Taylor Supply Company
Cumberland — Tri-State Mine & Mill Supply Co., Inc.
Hagerstown — Foltz Manufacturing & Supply Co.

MASSACHUSETTS
Attleboro — Reardon & Lynch Company, Inc.
Boston — Atlantic Pipe & Supply Co., Inc.
Conley Supply Co., Inc.
Pierce-Perry Co.
Brockton — Corcoran Supply Co. of Brockton, Inc.
Cambridge — Boston Pipe & Fittings Co., Inc.
Metropolitan Pipe & Supply Co.
R. C. Sullivan Company
Fall River — Corcoran Supply Co. of Fall River, Inc.
Gardner — Royal Supply Company
Holyoke — The Holyoke Valve & Hydrant Co.
Hyannis — R. B. Corcoran Co. of Hyannis
Lawrence — Bride, Grimes & Co.
Lowell — Middlesex Machine Company
Lynn — The Benevenel Corporation
New Bedford — Babbitt Steam Specialty Co.
Peabody — Boyle Machine & Supply Co.
Jefferson Industrial Supply, Inc.
Pittsfield — Berkshire Mill Supply Co.
South Boston — Charles D. Sheehy, Inc.
Springfield — Charles Miller & Son Co.
Westfield — Warner Supply Co., Inc.
Worcester — Washburn-Garfield Co.

MICHIGAN
Battle Creek — Kendall Hardware Mill & Supply Co.
Benton Harbor — Brammall Supply Co.
Detroit — The Cocn DeVisser Company
Flint — A. P. Engelhart & Co.
Grand Rapids — Hayden Supply Co.
Iron Mountain — Wittsch Supply Co.
Jackson — The Smith Winchester Co.
Kalamazoo — Kendall Hardware Mill & Supply Co.
Lansing — The Michigan Supply Co.
Muskegon — B. R. Fisher Co.
Saginaw — Reichle Supply Co.

MINNESOTA
Duluth — Duluth Plumbing Supplies Company
Minneapolis — Central Supply Co.

MISSISSIPPI
Jackson — Harper Foundry & Machine Co.
N. O. Nelson Co.
Meridian — Soule Steam Feed Works
Vicksburg — O'Neill-McNamara Hardware Co.

MISSOURI
Cape Girardeau — N. O. Nelson Co.
Jefferson City — N. O. Nelson Co.
Joplin — Joplin Supply Co.
Kansas City — Mid-States Supply Co.
Reeves-Wiedeman Company
No. Kansas City — Carroll Company, Inc.
St. Joseph — Missouri Water & Steam Supply Co.
St. Louis — Donley Pipe & Supply Co.
N. O. Nelson Co.
Springfield — John A. Rhodes Co.

MONTANA
Butte — Montana Hardware Company
M. & I. Supply Co., Inc.
Missoula — Missoula Mercantile Company

NEBRASKA
Lincoln — Western Supply Company
Omaha — John Day Rubber & Supply Co.
Midco Supply Co.

NEVADA
Reno — Acme Supply & Equipment Co., Inc.

NEW HAMPSHIRE
Concord — Page Belting Co.
Keene — Perkins, Bassett & Wright, Inc.
Manchester — Colonial Supply Corp.
Manchester Supply Company
Nashua — P. W. Webb Company, Inc.

NEW JERSEY
Atlantic City — Seashore Supply Company
Bayonne — Bayonne Plumbing Supply Co.
Bridgeton — Hajoca Corporation
Camden — Fleck Company
Hajoca Corporation
J. D. Johnson Co., Inc.
Elizabeth — Elizabeth Hardware Company
Harrison — William S. Rae, Inc.
Div. of Charles F. Guyon, Inc.
Irvington — Gerwick & Auerbacher, Inc.
Jersey City — The Ideal Supply Co., Inc.
New Brunswick — Behrer-Nason Company, Inc.
Raritan Supply Company
Newark — Geo. J. Keller Co.
John Simmons Company
Passaic — Central Engring. & Supply Co., Inc.
A & J Friedman Supply
Power Pipe & Supply Co., Inc.
Paterson — Federal Supply Co.
Paterson Supply & Engineering Co.
Perth Amboy — Madson & Maxwell, Inc.
Trenton — Manufacturers Selling Company
Vineland — Enolcott Supply Company

NEW YORK
Albany — Sager-Spuck Supply Co., Inc.
Binghamton — Binghamton Industrial Supply Co.
Chas. Millar & Son Co.
Ellis W. Morse & Co.
Sage Supply Co., Inc.
Buffalo — W. A. Case & Son Mfg., Co.
Stitt & Priebe, Inc.
Elmira — Irving D. Booth, Inc.
LeValley McLeod, Inc.
Ithaca — Haverstick & Co.
Jamestown — Clark Hardware Co.
Kingston — W. A. Case & Son Mfg. Co.
Long Island City — Canran Supply Co., Inc.
Gar Supply Corp.
Mayer-Malbin Company, Inc.
Middletown — Orange County Plumbing Supply Co.
Mineola — Behrer-Nason Company, Inc.
Newburgh — W. A. Case & Son Mfg. Co.
W. L. Smith Co.
New York City — Asco Supply Company, Inc.
Behrer-Nason Company
Davis & Worshow, Inc.
B. F. Gilmour Co., Inc.
Glauber, Inc.
Charles F. Guyon, Inc.
W. H. Mussey & Son, Inc.
H. R. Kelly Company, Inc.
McElravey & Mauck Co.
N. Y. Plumbers Specialties Co., Inc.
Herbert Rack Supply Corporation
Saltser & Weinsier, Inc.
Sidney Samuels, Inc.
Simplex Plumbing Supply Co.
Smalley Co., Inc.
The Smyth-Donegan Company
Standard Plumbing Supply Co.
John Wiffert Company
Niagara Falls — W. A. Case & Son Mfg. Company
The Elderfield Corp.
Haverstick & Co., Inc.
Ogdensburg — Utica Plumbing Supply Co., Inc.
Olean — LeValley McLeod, Inc.
Port Chester — Central Plumbers Supply Co., Inc.
Poughkeepsie — Interstate Plumbing Supply Co., Inc.
J. D. Johnson Co., Inc.
Rochester — W. A. Case & Son Mfg. Co.
Haverstick & Co.
Samuel Sloan & Co.
Syracuse — Burns Bros. Mfg. Co., Inc.
Edward Jay Co.
Utica — Chas. Millar & Son Company
White Plains — Behrer-Nason Company, Inc.
Woodside — Neill Supply Co., Inc.
Yonkers — Glauber, Inc.
Joseph C. Ryan & Sons, Inc.

NORTH CAROLINA
Asheville — Hajoca Corporation
Charlotte — Grinnell Company, Inc.
Hajoca Corporation
Textile Mill Supply Co.
The Henry Walke Company
Durham — Dillon Supply Co.
Noland Company, Inc.
Fayetteville — Piedmont Supply Co., Inc.
Standard Supply Co., Inc.
Gastonia — Gastonia Mill Supply Co.
Goldsboro — Dillon Supply Co.
Greensboro — Frank Hackett Supply Co.
Piping & Equipment Supply Corp.
Hickory — Piedmont Supply Co., Inc.
High Point — Kester Machinery Co.
Kinston — Noland Company, Inc.
Raleigh — Dillon Supply Co.
Noland Company, Inc.
Rocky Mount — Dillon Supply Co.
Salisbury — Piedmont Mill Supply Co., Inc.
Shelby — Shelby Supply Co.
Wilmington — Mill & Contractors Supply Co.
Wilson — Noland Company, Inc.
Winston-Salem — Kester Machinery Co.
Noland Company, Inc.

OHIO
Akron — Mahoning Valley Supply Company
Canton — Mahoning Valley Supply Company
Chillicothe — Grinnell Company, Inc.
Cincinnati — The Murdock Mfg. & Supply Co.
Cleveland — American Rad. & Std. Sanitary Corp.
Strong, Carlisle & Hammond Co.
Columbus — The Smith Bros. Hardware Company
Westwater Supply Company
Dayton — The Acme Plumbing Supply Co.
Dills Supply Company
Lancaster — The Roedel Hardware Co.
Lima — American Rad. & Std. Sanitary Corp.
Lorain — American Rad. & Std. Sanitary Corp.
Mansfield — Conte Plumbing & Heating Sup., Inc.
New Haven — New Haven Supply Co.
Sandusky — Brahl & Appell Co.
Steubenville — Industrial Supplies Co.
Toledo — The Hardy & Dschinger Co.
Youngstown — Valley Pipe & Supply Co.
Zanesville — Industrial Supplies Co.

OKLAHOMA
Oklahoma City — Midske Supply Co.
Tulsa — Ardun Supply Company
Marshall Supply & Equipment Co.

OREGON
Astoria — Fisher Bros.
Eugene — American Steel & Supply Co.
No. Portland — Moore Dry Kiln Co.
Portland — Harris Supply Company
J. E. Hasseltine & Co.
Paramount Supply Co.
Salem — Salem Steel & Supply Co.

PENNSYLVANIA
Allentown — Lehigh Valley Supply Co.
Bethlehem — Hajoca Corporation
Chester — Hajoca Corporation
Easton — H. P. Kinsey Company
Erie — Palace Hardware Supply Company
Franklin — Valley Industrial Supply Co.
Harrisburg — Appleby Bros. & Whittaker Co.
Haverford — Plumbers Supply Co., Inc.
Lancaster — Herr and Company, Inc.
Lansdale — Hajoca Corporation
Norristown — United Pipe & Supply Co., Inc.
Philadelphia — Herman Goldner Co., Inc.
Grinnell Corporation
Hajoca Corporation
Henry B. Pancoast Company
C. J. Reinaer & Inc.
Pittsburgh — Pittsburgh Gage & Supply Co.
Pottsville — Reading Foundry & Supply Co.
Reading — Hajoca Corporation
Reading Heater & Supply Company
Scranton — Ralph E. Weeks Co.
Sharon — Pittsburgh Gage & Supply Co.
Titusville — Pittsburgh Gage & Supply Co.
Wilkes-Barre — Eastern Pennsylvania Supply Co.
Williamsport — E. Keeler Company
York — Fulton, Mehring & Hauser Co., Inc.

RHODE ISLAND
Providence — Allen & Reed Company
Grinnell Company, Inc.
Rhode Island Supply & Eng'ring Co.
Woonsocket — Woonsocket Supply Company

SOUTH CAROLINA
Anderson — Sullivan Hardware Co.
Charleston — B. L. Montague Co., Inc.
Noland Company, Inc.
Clinton — Industrial Supply Co.
Columbia — Columbia Supply Co.
Noland Company, Inc.
Greenville — Poe Hardware & Supply Co.
Stewart Supply Co.
Sullivan Hardware Co.
Spartanburg — Hall & Company, Inc.
Noland Company, Inc.
Sumter — B. L. Montague Co., Inc.

TENNESSEE
Bristol — Mitchell-Powers Hardware Co.
Chattanooga — Mills & Lupton Supply Co.
Jackson — Southern Supply Co.
Kingsport — Greene Hardware & Supply Co.
Knoxville — Tennessee Mill & Mine Supply Co.
Memphis — E. C. Blackstone Co.
N. O. Nelson Co.
Nashville — Buford Brothers, Inc.
W. A. Case & Son Mfg. Co.
Noland Company, Inc.

TEXAS
Austin — K & M Supply Company
Dallas — N. O. Nelson Co.
El Paso — Zark Hardware Company
Fort Worth — Well Machinery & Supply
Houston — Corbett Corp.
N. O. Nelson Co.
Lufkin — Supply Div. of Lufkin Const. Co.
Marshall — E. B. Noyes Machinery Co.
Paris — Robert L. Swain Co.
San Antonio — San Antonio Pipe & Supply Co.
Texarkana — Buhrman-Pharr Hardware Co.

UTAH
Salt Lake City — N. O. Nelson Co.

VERMONT
Burlington — The Bladgett Supply Co., Inc.
Rutland — Conney-Flue, Inc.
St. Johnsbury — Charles Millar & Son Co.

VIRGINIA
Charlottesville — Noland Company, Inc.
Danville — Hajoca Corporation
Lynchburg — Barker-Jennings Corp.
Newport News — Noland Company, Inc.
Norfolk — Hajoca Corporation
The Henry Walke Company
Richmond — Hajoca Corporation
Industrial Supply Corporation
Noland Company, Inc.
Southern Railway Supply Co.
Roanoke — Graves Humphreys Hardware Co., Inc.
Noland Company, Inc.
Waynesboro — Mize Supply Company

WASHINGTON
Seattle — Northern Commercial Co.
Steam Supply & Rubber Co.
Spokane — Northwest States Supply Co.
Sullivan Valve & Engineering Co.
Tacoma — Paramount Supply Co.
Walla Walla — Drumheller Co.

WEST VIRGINIA
Charleston — McJunkin Corporation
Clarksburg — Osborn Machinery Co., Inc.
Huntington — Logan Hardware & Supply Company
Logan — Logan Hardware & Supply Company
Weston — Danner Hardware & Supply Co.
Wheeling — Trimble & Lutz Supply Co.

WISCONSIN
Appleton — W. S. Patterson Co.
Green Bay — Murphy Supply Co.
Kenosha — P. H. & I. Supply Co.
LaCrosse — W. A. Roosevelt Co.
Madison — Automatic Temperature Supplies, Inc.
Rundle Spence Mfg. Co.
Manitowoc — William Rathsack & Sons Co.
Milwaukee — F. R. Dengel Co.
B. Hoffmann Mfg. Co.
Div. Grinnell Company, Inc.
Rundle Spence Mfg. Co.
Nekoosa — Nekoosa Fdry. & Mchne. Works, Inc.
Oshkosh — Bottle Bros.
Racine — Thomas Supply Co.
Sheboygan — Optenberg Iron Works
Watertown — Kusel Dairy Equipment Co.

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BRONZE • IRON • CAST STEEL • STAINLESS STEEL

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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING.

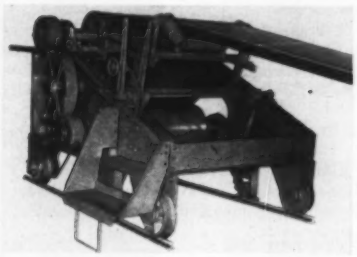
NEW EQUIPMENT

Fence-Coating Tool

A new kind of lamb's-wool roller designed expressly for fence maintenance, featuring an extra-long $1^1/_2$ in. nap, has been developed by the Rust-Oleum Corp., 2799 Oakton St., Evanston, Ill.

The nap reaches around the fence wires and coats about 70 per cent of the opposite side of the wire in one stroke, the company says. The length was determined as the length that gives the greatest wrap-around action without matting down on adjacent fence wires.

According to the company, oversize sleeve diameter gives the roller greater carrying capacity and minimizes waste and spatter, and 99 per cent of the material goes on the wire itself and not on the ground or on the workers.



Belt Conveyor Tripper

A belt conveyor tripper accommodating long center roll, deep-troughing idlers has been developed by Stephens-Adamson Mfg. Co., Aurora, Ill., for use with belt conveyors handling light materials.

Its principal use will be for grain, wood chips and similar materials, the company says. By changing drive mechanism from shaft to chain transmission, the tripper clears 45 and 35 deg grain-type idlers, and also keeps headroom requirements to a minimum. A self-propelled unit, it has a manually-operated friction drive which allows travel against and with direction of belt travel. Other features include heavy gage steel unit construction, Sealmaster main bearings and choice of left hand or right hand operation.

Printed Circuits

Preparation of printed electrical circuits for etching can now be done by xerography, Haloid Co., Rochester 3, N. Y. has announced.

In the new application, the powder image peculiar to xerography—a fast, dry, electrostatic method of copying, heretofore used chiefly in office and graphic arts reproduction—is transferred from a XeroX selenium plate to a sheet of transfer paper, thence to the face of a copper-clad laminate. Here the powder forms a photo-exact resist pattern impervious to chemical attack.

Since, in the etching step which follows, acid eats away all the copper unprotected by resist, the result is metal left only where specified by the original circuit drawing. The xerographic powder or resist, having accomplished its purpose, is then removed by solvent, disclosing the completed print ready for dip-soldering to "pig tails" or other contacts.

From an original opaque drawing, a copper-clad laminate serving as a printed circuit or wiring board can be prepared for etching in about 10 minutes, the firm states. Except for the final etching step, the xerographic approach is entirely dry, requiring neither conventional photographic materials nor darkroom facilities.

Cold Water Insulation

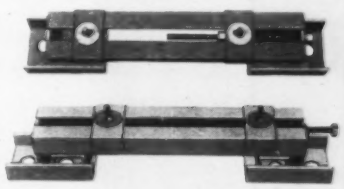
Philip Carey Mfg. Co., Dept. PI, Cincinnati 15, Ohio, announces improvements in the field of cold water insulation. The company says complete control of thickness of its insulations is now available.

In addition, the use of less adhesive in combining the insulating felts has been made possible, the company says, to reduce the amount of shrinking. Impervo is specified for use on ice water and cold water pipes to keep water cold and prevent sweating. Perfecto can be used for hot or cold water pipes and Protecto is used to reduce the danger of freezing of exposed water pipes.

Flush-Feeder

High concentration slurry solutions and corrosive liquids are said to be effectively handled by a simple flush-feeder developed by Proportioneers, Inc., Div., B-I-F Industries, Inc., Providence, R. I. Because of its ability to pump slurries of thin mud-like consistency, a fairly small make-up tank can often hold enough slurry for several days operation, the company says.

A unique check valve assembly mounted directly on the slurry tank is separated from the metering pump so that slurry cannot enter the primary displacement cylinder. Since only water passes through the reagent ends of the feeder, the detrimental factors which make slurries and corrosive liquids hard to handle are eliminated. The seat of the check valve assembly is flushed clean at every stroke of the pump, with the duplex action of the diaphragm pump providing a positive slurry flow down to .75 gph.



Motor Isolation Base

A duplex slide-rail motor base said to be a high efficiency, vibration-and-noise-isolating base featuring an exclusive slide mechanism that provides speedy belt tensioning, simple installation, and versatility of application has been announced by The Korfund Co., Inc., 48-15 32nd Place, Long Island City 1, N. Y.

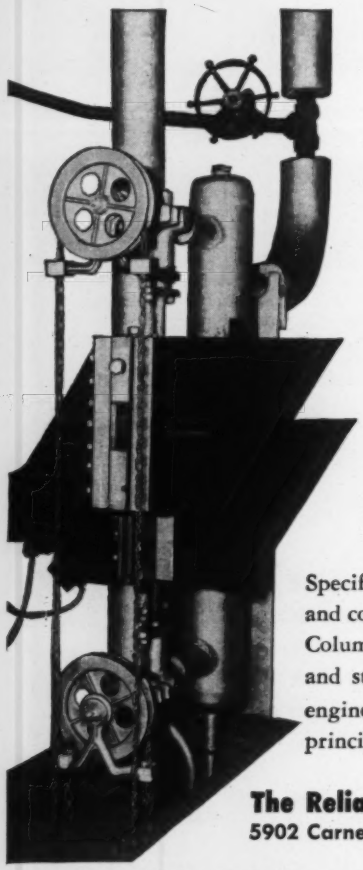
According to the company, the patented design of twin angle-iron construction assures utmost structural rigidity, and together with the built-in slide rail feature permits full adjustability of the motor for rapid equipment installation. This design also permits the slide mechanism to be located within the base, rather than on top of it.

Full adjustability, and the use of individual rails permit the use of the same isolation base with a broad range of motor sizes. The design accommodates 29 different motor sizes with only six standard base sizes.

Reliance Water Columns

Gages and Safety Specialties

assure you the utmost in *Dependability*



Since 1884, Reliance has maintained leadership in Boiler Safety Device development and manufacture. Water Columns with automatic Alarms, operated by the original *instantaneous* alarm mechanism, have helped to fortify power plants against the consequences of boiler water failure for billions of operating hours. Whistle alarms are available on columns for pressures to 900 psi; electric alarms, actuated by Reliance Electrode Levalarms, to 2500 psi.

For higher pressures — to 2500 psi — Reliance standard and custom-built equipment embodies principles of design and construction perfected in 70 years of *specializing* in this field—"super-rugged" Water Columns built with a generous margin of safety and tested at twice rated capacity.

Specified by many boiler manufacturers and consulting engineers, Reliance Water Columns exceed requirements of national and state code authorities . . . Reliance engineer representatives are located in all principal cities. Write for Bulletin 516.

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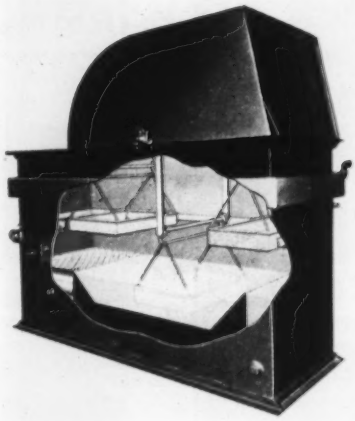
Gage Inserts: Prismatic, Mica-protected Flat Glass, "Micasight"
Direct-to-Drum Water Gage Assemblies
Complete Line of Water Gage Illuminating Equipment
EYE-HYE Remote Reading Water Level Indicator — all pressures
Levalarms — Float-type Liquid Level Alarm Devices
Levalarms — Electrode-type Liquid Level Alarms, Fuel Cut-out and Pump Control

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS



Vapor Degreaser

A new type vapor degreaser has been announced by Phillips Mfg. Co., 3531 W. Touhy Ave., Chicago 45, Ill. The unit operates on the company's rotomatic principle to permit a pre-determined and accurately controlled degreasing time-cycle. A cool dip rinse has been incorporated on the new unit to wash off chips and other insolubles.

The dip cycle operates in two ways. The liquid solvent rinse gets back into blind holes and recesses in the work being degreased. In addition the work is cooled so that in each complete cycle of baskets or tumblers there are two separate condensing vapor stages.

Straight work baskets are used where work is relatively free from recesses or the tendency toward nesting. If these conditions do exist the unit is available with tumblers which provide thorough cleaning action. Time cycles are adjustable. A flusher spray attachment is available.

The units range in size from 1800 to 4000 lb per hour and are available in electrically heated, steam heated and gas heated models.

Screw Feeder

A screw feeder for flow regulation of flue dust, ore fines and other granular materials has been developed by William M. Bailey Co., 1221 Banksville Rd., Pittsburgh 16, Pa.

The unit was developed to regulate flue dust feed from dust catchers and hoppers to pug mills, conveyors and bins. It is said to be particularly valuable in maintaining a uniform flow where irregular feeding may be caused by hanging of material in the dust catcher or by a sudden furnace slip.

Design features include a screw made in sections, for easy replacement; square screw shaft to simplify screw replacement; roller type bearings mounted in split cast iron housings. When service is to include handling highly abrasive materials, the feeder is equipped with a cast ferromanganese screw, supplied with a hard facing on the edge and wearing face.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Rust Spray

A rust preventive spray for use on tools, molds, dies, instruments, nested metal parts and machinery is in production at Eastern Aerosol Products, Newfoundland, N. J.

Known as "Rust Chek," the new compound is packaged in a 12-oz aerosol spray container. According to the firm, a can provides approximately 80 sq ft of coverage in the form of a clear, dry, waxy film to a thickness of .0005. Except in the case of use on precision instruments where critical tolerances are to be held, the film need not be removed when the protected tool, mold or machinery is removed from storage or tool crib and readied for use. The film is worked off in the using, and in some applications, such as on power saws, it serves as a lubricant.

In tool, mold, and other applications in which the material is designed to simplify the work of applying a preservative, the manufacturer claims it has advantages over oil or grease in that it does not absorb dust and dirt. Submersion tests in salt water and in other liquids simulating various industrial atmospheric conditions indicate that the new product will provide complete and permanent protection for tools, dies, molds, machinery and metal surfaces during storage periods or in transit. It can also be used outdoors where permanent or temporary coatings are required for machinery, motors, unpainted metal containers and equipment.

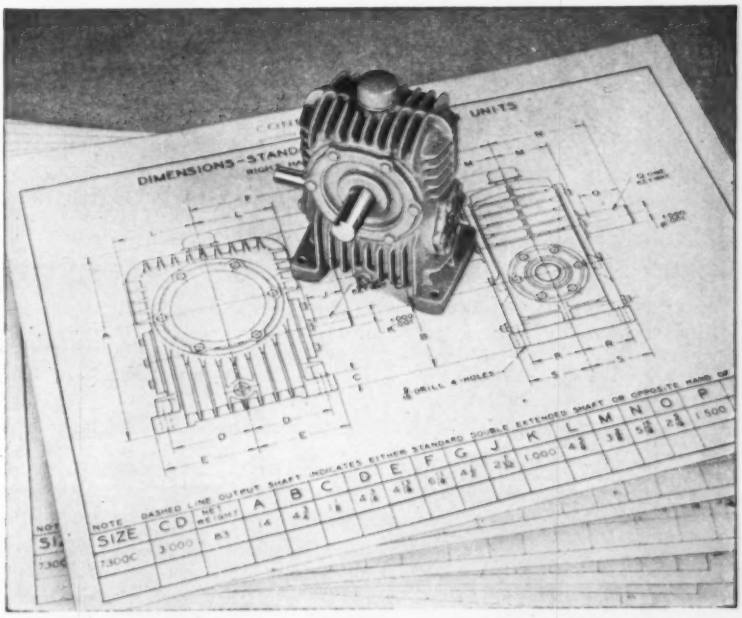
Belt-Driven Pump

A new belt-driven pump for passenger car and truck oil-hydraulic power steering systems which features reduced package size of exceptionally short overall length is now available from Vickers Inc., Detroit 32, Mich.

The pump, designated Model VT-26 measures in length $3^{7}/_{16}$ in. from mounting face to rear and $5^{1}/_{32}$ in. overall. The pump weighs 9.65 lb exclusive of bracket and pulley. Rated capacity is 5 gpm at 1200 rpm. Pressure connection is SAE inverted flare-type fitting for $^{3}/_{8}$-in. diameter hose; return connection is for clamp-on hose.

The integral relief valve and integral flow control are located at right angles to the center line of the pump. The relief valve provides system overload protection within a range of 750–1050 psi. The new pump is designed for system operating pressures which vary between 100 and 1000 psi, depending on steering loads.

According to the company, the flow control limits delivery to the power steering system to 2.3 gpm regardless of engine speed and actually reduces flow at the higher rpm's where system delivery requirements are lower. This reduced flow at higher speeds is said to result in lower system operating temperatures than are normally possible with a conventional flow control design. The pump inlet is subjected to a hydraulic supercharge through use of the jet pump principle.



DIMENSIONS ONLY TELL HALF THE STORY...

. . . about worm gear speed reducers. You've got to compare size with load capacity for the whole picture. Inside a Cone-Drive speed reducer you'll find the double-enveloping worm gear design that makes it the most efficient right-angle speed reducer available.

Take the standard 3" center distance unit above for example. Here are its Class I Service Ratings with a 5:1 reduction:

Worm RPM	100	200	300	580	720	870	1150	1750
Mech. HP	1.24	2.21	3.08	4.89	5.61	6.34	7.41	9.04
Thermal HP	1.24	2.21	3.08	4.20	4.62	5.10	6.00	7.80
Output Torque (inch-lbs.)	3340	3010	2830	2405	2250	2150	1940	1575

That's a lot of capacity for a unit that occupies less floor space than this magazine page. But it's typical of Cone-Drive speed reducers and gearsets. Complete details on this model in Bulletin 600-C. Other units to 800 HP and ratios to 4900:1.

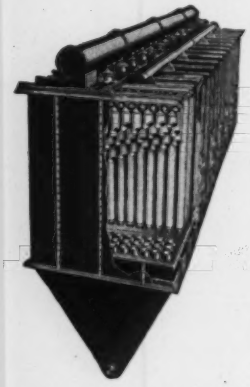
CONE-DRIVE GEARS
Division Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNichols Road • Detroit 12, Michigan

Norblo solves dust problems

Whatever you need in dust or fume control, be sure to check *Norblo*

In Bag Type, Centrifugal or Hydraulic dust collecting systems, Norblo Dust and Fume collection equipment has many design advantages. These three types, frequently used in certain combinations, provide economical dependable control as required in smelting, rock products, chemical, milling and processing fields.

What is the best approach to your dust problems? Norblo helps you select—applies engineering skill and "know how" gained in first hand experience of over 40 years in many industries.



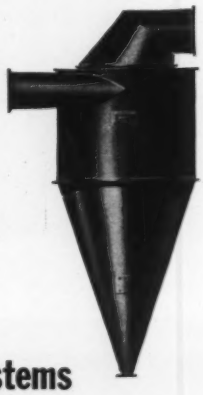
Norblo Bag Type Systems

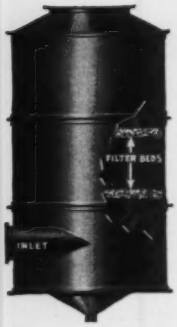
Automatic and Standard

For continuous or heavy duty service providing very high efficiency at very low cost of operation and maintenance. Basic unit contains 78 bags, 6″ diameter, 8′ 3″ long. Air flow is upward, from inside, thus keeping bags fully distended. Total free cloth area per compartment 936 square feet. Shaking and cleaning controlled by electric timer, is cyclic, one compartment at a time, each having its individual compressed air shaker mechanism and the whole system variable and adjustable for dust load without shutting down . . . Also Norblo Standard Bag Type (non-automatic).

Norblo H. E. L. S. Centrifugal Systems

A cyclone or centrifugal type collector for all materials, from sawdust to fly ash; characterized by high efficiency of collection with low static drop. The Norblo H. E. L. S. has no internal vanes, gadgets or dampers. High efficiency is obtained by scientific proportioning and by the patented (No. 2,259,919) expanding nozzle. These design features eliminate the power-wasting back eddy. Built in standard sizes with capacity up to 37,500 cfm.





Norblo Hydraulic Systems

A high efficiency, wet type collector, for separation of dust mixed with smoke or fumes. In most installations the Hydraulic unit is used with a Norblo Cyclone collector, thus reducing the amount of wet sludge to be handled. No moving parts. Filter beds are coke or high-fired ceramic tubes, light weight and kept in motion by ascending air stream. Beds are self-cleaning. Built in standard sizes with capacities up to 26,000 cfm.

Take advantage of the efficiency and low maintenance available through Norblo Equipment in these three proved systems of dust and fume collection. Write for full information.

The Northern Blower Company
6421 Barberton Ave., Cleveland 2, Ohio • OLympic 1-1300

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Alignment Interferometer

An experimental alignment interferometer to measure changes in angle of arc to 0.000001 in. accuracy has been developed by the Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.

The firm says it plans to build a limited number of the new instruments and provide in-plant demonstrations for prospective users.

The instrument is a double-beam interferometer built to detect small changes in angle through a total range of 30 seconds of arc. In operation, light beams from within the main body are reflected back from a mirror that can be located as much as 14 ft away.

The interferometer can be rested on its base, side, or end to measure the alignment of jigs, fixtures, or flat bed surfaces. The 30 seconds of arc range is graduated as plus or minus 15 second intervals around a central zero point. The least scale reading is 0.2 second of arc, and the maximum accuracy is 0.000001 in.

Readings are obtained by setting the interferometer and mirror into zero alignment. When the mirror is moved, fringes are observed through the eyepiece and brought back into the zero alignment position by resetting the measurement scale, which then indicates the change in the angle of arc.

Missile Motor

An air motor announced by Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif., is of a constant displacement rotary vane design for missiles.

With the exception of the blades and bearings, the motor is fabricated entirely of aluminum. The basic motor weighs $1^1/_2$ lb and develops $2^3/_4$ hp per 100 psi of inlet pressure. The company says it will perform satisfactorily with inlet pressure of 300 psi. Overall efficiency approaches 70 per cent at speeds between 3000 and 6000 rpm. The firm states the motor has been completely qualified for missile applications over an ambient range of −20 F to 160 F and accelerations of 60 G. Recent tests have illustrated the ability of the motor to withstand inlet gas temperatures in excess of 1000 F for as long as two minutes. Unlike conventional motors of this type, no in line lubrication is required, the company says.

The motor contains a unique governor which maintains a constant speed within 2 per cent for load transients of 10 per cent. This governor, the firm says, regulates motor speed from regulated inlet pressures of 300 to 600 psi without the use of a reference spring. This latter feature permits the use of this motor with a 1000 F power source. Upon application of the supply pressure the motor will stabilize at regulated speed within .2 seconds. The motor with its governor is used to run an alternator, while a motor without a governor is presently used for hydraulic drive.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Selector Valve

A solenoid operated two-position four-way selector valve has been designed by General Controls, Skokie, Ill.

The new valve provides flow control of air, oil, gas or other semi-lubricating fluids at pressures up to 600 psi. The company says outstanding features of the valve include variable flow pattern, high speed operation, long service life, packless construction and multipoised design which permits operation in any position.

The valve is recommended by the company for small pressure actuated cylinder control.

Plastic Molding Inserts

Threaded inserts for plastics, rubber, die castings and potting compounds have been announced as standard stock items by Standard Insert Co., 12270 Montague St., Pacoima, Calif. The inserts are designed to be molded directly into the product, and require no secondary operations for inserting or locking.

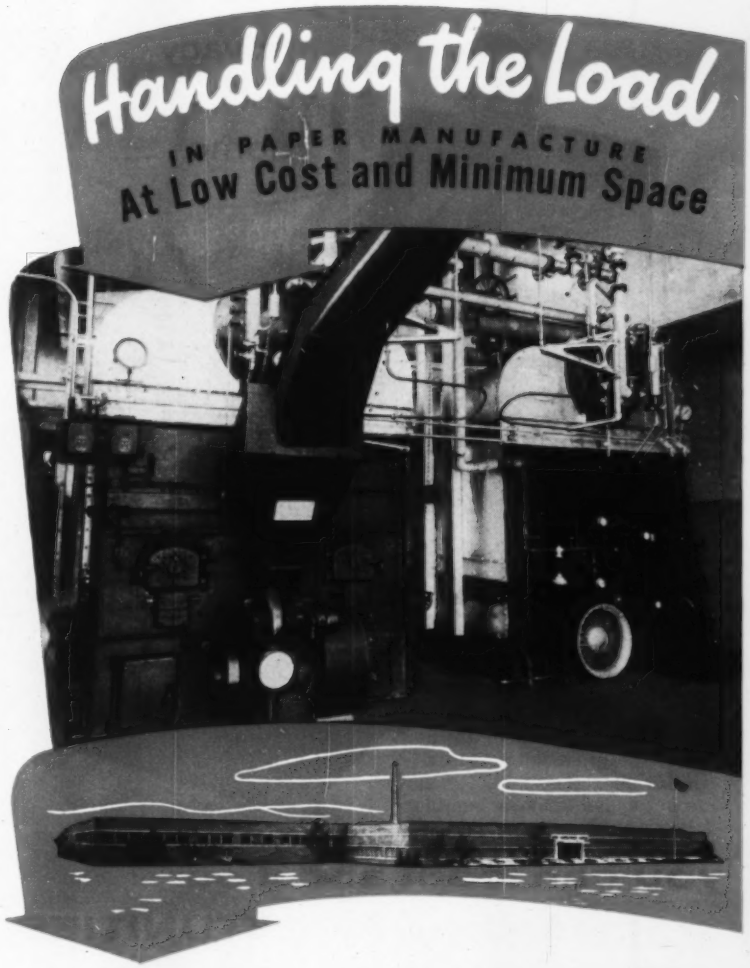
The inserts are knurled to prevent rotation and hold them in place. Additional strength against pullout is obtained by two circular relief bands on each insert. They are available in sizes from No. 2 to $^{3}/_{8}$ in. in all regular thread sizes, both NC and NF.

The inserts are made in two series: tapped straight through and blind. Class 2 threads are standard, and Class 3 is available. Standard material is brass, but the units may be made to order from steel, aluminum or stainless.

Milling Grade Carbide

Pin-pointed especially for milling high tensile cast irons, a new milling grade carbide, developed by Carboloy Dept., General Electric Co., Detroit 32, Mich., is said to provide between 20 to 30 per cent better tool life than carbide grades now available commercially for this type of milling.

Because of its composition and structure, the carbide, referred to as grade 860 by its producers, makes available to users a cutting edge that is stronger and more resistant to chip-outs or cratering. According to the company, the new development is especially adapted for milling the newer types of gray cast irons which include additives to provide denser structures. Such cast irons are in the higher hardness range of 223 to 248 Brinell.



TITUSVILLE TICOTHERM
STEAM GENERATORS

For Paper Manufacturers Company, at their Bustleton, Pa. plant, two main types of firing are handled efficiently by these Titusville TICOTHERM Steam Generators. No. 1 boiler has a ram-type underfeed stoker, No. 2 is equipped with oil burner for standby, providing flexibility for all processing and heating needs of the large plant pictured.

Write for your copy of informative Ticotherm Bulletin B-3250A —sent promptly on request.

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Pratt & Whitney Aircraft, East Hartford, Conn.

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☐ Turbines ☐ Gears ☐ Controls
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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

High Production Reamer

Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich., announces a special type reamer specifically designed for high production operations.

Designated Hercules "Altercut" chucking reamers, the tools feature alternate right and left hand spiral cutting edges. The company says this construction produces a double cutting action as each cutting edge is preceded and followed by an edge that cuts at a different angle to the axis of the hole being reamed.

According to the manufacturer, the double spiral design prevents chattering and also helps relieve strains imposed upon the reamer. It is claimed that this results in less dulling of the cutting edges and consequently provides a greatly increased number of accurate, fine-finished holes between grinds.

The reamers are available in both high speed steel and carbide, in straight and taper shanks. Size range is from $\frac{1}{4}$ to $1\frac{1}{2}$ in. diam.

Track Scale

Streeter-Amet Co. has perfected an electronic weighing track scale for weighing freight while it is in motion on the track. The company says the unit is the fastest of all electronic weighing equipment recording the weight of the freight accurately and quickly upon a tape or ticket. An illustrated bulletin may be obtained by writing the company, 4101 Ravenswood Ave., Chicago 13, Ill.

Propeller Fan

Propellair Div., Robbins & Myers, Inc., Springfield, Ohio, has introduced a new line of direct-connected axial flow fans designed for air moving applications requiring low noise level operation.

Designated as Type QD by the manufacturer, the new fans are designed for offices, stores, restaurants, laboratories, institutions and other applications requiring the quiet movement of large volumes of air. Available in six sizes from 12 through 36 in., the new fans have air delivery ratings to 12,000 cu ft per minute.

A new design cast aluminum airfoil propeller operating at low speed is said to account for quiet operating characteristics.

The company says the propeller will operate continuously without the danger of bending fatigue generally encountered with pressed sheet metal blades. The thick airfoil design of the propeller also eliminates the sounding board effect of thinner sheet metal blades.

The venturi design of the fan's mounting ring prevents air recirculation at the propeller tips. The fans are powered by totally-enclosed, continuous duty, 115/230 volt, permanent split capacitor motors. There are no centrifugal switches or brushes. The fans can be adapted for 2-speed operation as well as variable speed operation.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Electric Indicator

To provide accurate control for grinding close tolerance tapers, Norton Co., Worcester 6, Mass., has developed a Swivalign dual electric indicator for measuring swivel table adjustment.

This device, applicable to the firm's cylindrical and universal grinding machines, is said to simplify the adjustment of swivel tables to correct errors in grinding exact tapers or to eliminate taper in straight work.

It consists of one electrical pick-up unit with zero adjusting knob at each end of the swivel table and a two channel amplifier having a pair of indicating meter elements reading on a common scale. Each meter needle responds to movements of only one of the pick-up elements.

Connections are so arranged that both needles move in the same direction of rotation as the swiveling of the table. Thus if the table is swiveled clockwise (as viewed from above) the needles rotate clockwise and vice versa.

Divisions on the meter scale indicate directly taper changes in thousandths of 1 in. per ft of taper. Two ranges of readings, one for extremely accurate settings with graduations of .0001 in. per ft, and the other .0005 in. per ft of taper change are provided. The desired range is obtained by a selector switch on the front of the instrument case. A conversion chart on the side of the instrument case gives taper foot values for corresponding micrometer readings of work diameters.

Centrifugal Pumps

An improved line of centrifugal-type pumps designed for transporting mixtures of abrasive materials such as ash, slag and fly ash from power plants and coke from petroleum plants is announced by Allen-Sherman-Hoff Co., 259 E. Lancaster Ave., Wynnewood, Pa.

Designated the Hydroseal line, the pumps are available in two types and many sizes. One type employs rubber, neoprene or other synthetic lining and is designed for pumping fine solid materials, especially where resistance to chemical action is important. A second type employs hard metal alloy wearing parts for handling sharp edged solids that would tend to cut the softer, nonmetallic linings.

The pumps employ the principle of having a small stream of clear water flow continuously through the clearance spaces between the rotating impeller and the stationary parts into the shell (volute) and suction eye of the impeller. This clear seal water effectively protects the shaft, stuffing box and suction sea from abrasive-laden water, and thus eliminates possibilities of frictional wear and enlargement of running clearances between moving parts, the company says. It is also said to forestall recirculation of the solid-fluid mixture back to the suction eye of the impeller, thereby eliminating double pumping.

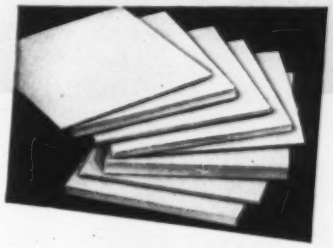
TEFLON*

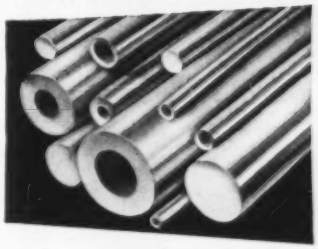
SHEET....ROD....

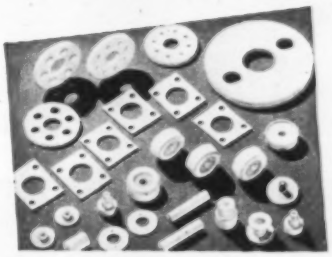
TUBING....MOLDED OR MACHINED PARTS?

YOU CAN GET JUST WHAT YOU WANT

from JOHN CRANE







*TEFLON DuPont trademark

Advantages:

CHEMICAL—Completely inert
ELECTRICAL—Extremely low power factor
Very high dielectric strength
THERMAL—Temperature range
—300°F. to +500°F.
MECHANICAL—Strong, flexible
Weather resistant
LOWEST COEFFICIENT OF FRICTION
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Now is a good time to put "John Crane" to test. Contact Crane Packing Company today.

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SANDIA CORPORATION, a subsidiary of the Western Electric Company located in Albuquerque, N. M., is engaged in the design and development of nuclear weapons under contract with the Atomic Energy Commission. Compensation is competitive with that offered in other industry, and employee benefits include exceptionally liberal paid vacations, free group life insurance, sickness benefits, and a generous contributory retirement plan. Interview and liberal relocation expenses are paid by Sandia Corporation. Albuquerque, center of a metropolitan area of 186,000, is located in the Rio Grande Valley, one mile above sea level. Urban shopping facilities, scenic beauty, historic interest, year-round sports, and sunny, mild, dry climate make Albuquerque an ideal home. Housing is readily obtainable.

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If you wish to submit a more complete resumé of your qualifications, we will be happy to give it full consideration immediately.

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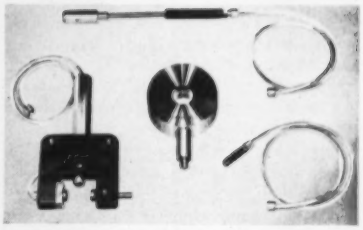
KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS



Air Gaging Instrument

An improved column-type air gaging instrument designed to provide finer accuracy and maintenance-free operation as well as greater versatility, ease of operation, and longer gaging element life, is announced by the newly formed Air Gage Div., Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.

Introduced under the trade name "Dearbornaire," the new air gaging instrument incorporates several advanced design and engineering features which are said to reduce down time to a minimum by eliminating nuisance interruptions for cleaning and service. Among the major design features are: a higher rated pressure system, combined with built-in circuit restrictions; an exclusive new glass tube possessing a characterized internal taper to provide linear accuracy over the full extent of the calibrated scales.

In addition, the new tube design is said to permit greater clearance between float and tube wall, eliminating the restrictive action of air borne oils and moisture and the need for frequent cleaning.

The instruments are available as single or multiple column units in standard amplifications of 1250 to 1, 2500 to 1, and 5000 to 1, or any combination thereof. For all three amplifications, zero is centered at midpoint on the calibrated scales.

Mist Collectors

An expanded line of mist and vapor collectors has been announced by Aget Mfg. Co., Adrian, Mich. Now totalling four units that range in capacities from 614 to 3600 cfm, the collectors are specially designed for machining or grinding operations where a liquid coolant produces mist or vapors.

The collectors are non-electronic type, which employ a specially compressed filter of fiberglas as the condensing element. This condenses the vapor and mist drawn from its source into the collector by a motor driven exhauster.

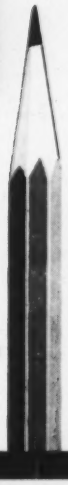
Where conditions allow, the mist collectors let the air return to the working area and the recovered coolant returns to the reservoirs, sump or waste, according to the company. Where heavy smoke or obnoxious odors result from grinding operations, an exhaust shell, which fits all models, can be added to expell the filtered air out of doors.

Continued on Page 50

Is Your Vision Good Enough To See This?...

Dramatic expansion today is being made in the field of synthetic chemical fibers. Equal expansion is now going on at Chemstrand, already a leader in this field. The full story is tremendous.

Challenging, ground-floor advantages for career advancement await engineers who today have the vision to see the future possibilities offered.



WRITE TODAY if you think you can qualify for a position on Chemstrand's team.

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The Chemstrand Corporation
Decatur, Alabama

Gentlemen:
It is my understanding that you need for immediate employment graduate engineers in various fields, particularly chemical, mechanical, industrial, textile and instrument engineering.

I am a graduate_____engineer.
Please send me information concerning the ground floor opportunities at Chemstrand.

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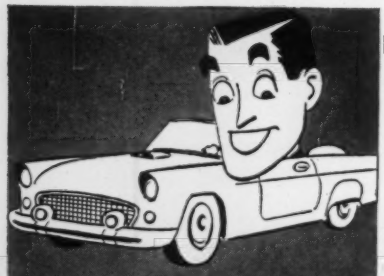
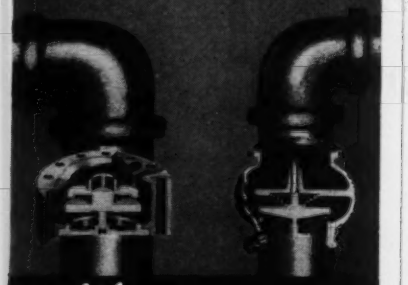


FORD

PROTECTS

PIPING SYSTEMS

IN 20 MODERN PLANTS



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For service in systems handling
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No. 654 on the Valves

No. 851 on Cause, Effect and Control of Water Hammer

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Lift Truck

The operating advantages of the firm's Monomast lift truck are available for the first time on a pneumatic-tired truck, the QN-20 of 2000 lb capacity at 24 in. load centers, according to an announcement by Hyster Co., 2902 N. E. Clackamas St., Portland 8, Ore.

The new lift truck is claimed to be an ideal "work horse" for both inside and outside production. Specific operating advantages, the result of single-upright visibility, include faster load placement, reduced driver fatigue and greater safety, the company says. Rigidity and stability factors of the truck's upright assembly are reported by the company to be unexcelled.

The truck is powered by a heavy-duty air-cooled Wisconsin gasoline engine and is equipped with pneumatic tires for dependable performance on all surface conditions.

Miniature Wafer Switch

A line of low-cost miniature rotary switches for instruments, computers, RF switching, and other electric-electronic applications has been announced by Shallcross Mfg. Co., Collingdale, Pa.

The switches are available in both shorting and non-shorting types with from one to four poles per deck and two to 32 positions per deck. Up to six decks may be ganged. A newly-designed, easily adjusted stop limits switch rotation to less than the maximum number of positions if desired. Positive indexing, regardless of the number of decks used, is provided by two stainless steel ball bearings held in a circular, flat, stainless steel spring. Torque is from 3 to 5 in.-lb for a single deck switch.

The switch measures $1^3/_4$ in. square and has a back-panel depth of 1 in. for the first deck, plus $^5/_8$ in. depth for each additional deck. Switches may be mounted by the conventional shaft bushing or flush-mounted to the panel by using two holes in the front plate.

Two self-cleaning, self-aligning contact arms with individual spring action provide a uniformly low contact resistance of 0.0015 ohm or less. Solid silver alloy is used for all contacts, arms, and collector rings. Nominal contact breaking capacity is 5 amperes at 125 v alternating current.

Induction Resolver

A new, size 11, high accuracy induction resolver with a total functional error of 0.01 per cent is announced by Diehl Mfg. Co., Somerville, N. J.

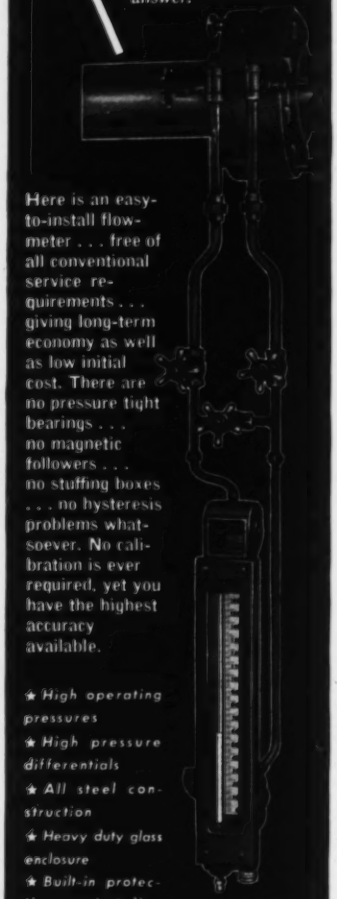
Designed to meet the environmental requirements of the armed forces, the new resolver is completely machine wound. The resolver has a high input impedance, permitting an excitation voltage of 110 v a-c at 400 cycles.

The company says the new resolver can function at a 70,000-ft altitude without pressurization. The component is provided with a pin-type base and mating connector.

UNMATCHED ACCURACY

in direct flow indication

Wherever you seek simplicity and high accuracy in flow measurement at lowest cost, the Meriam "H" Meter is the well-known answer.



Here is an easy-to-install flowmeter . . . free of all conventional service requirements . . . giving long-term economy as well as low initial cost. There are no pressure tight bearings . . . no magnetic followers . . . no stuffing boxes . . . no hysteresis problems whatsoever. No calibration is ever required, yet you have the highest accuracy available.

★ *High operating pressures*
★ *High pressure differentials*
★ *All steel construction*
★ *Heavy duty glass enclosure*
★ *Built-in protection against line surges*

Write for Bulletin 18A

Meriam Manometer Instrumentation

...for pressures, vacuums, flows, liquid levels.

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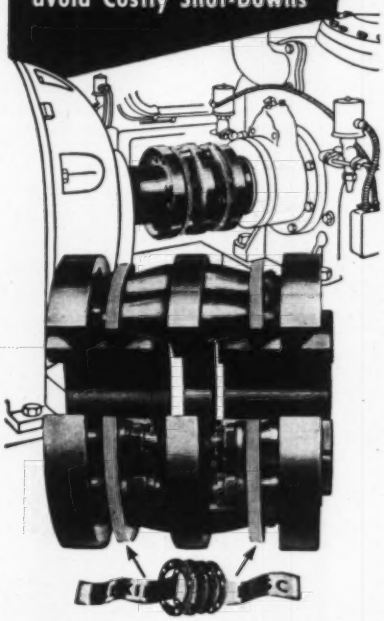
INSTRUMENT COMPANY

10920 Madison Ave. • Cleveland 2, Ohio

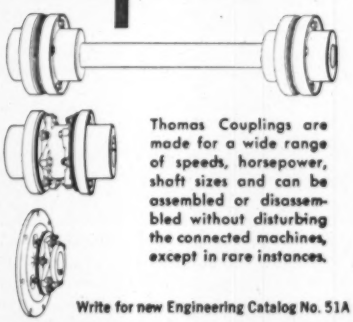
Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

DISTINCTIVE ADVANTAGES

FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Thomas Couplings are made for a wide range of speeds, horsepower, shaft sizes and can be assembled or disassembled without disturbing the connected machines, except in rare instances.

Write for new Engineering Catalog No. 51A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Tube Race

A tube race has been developed by the Instrof Corp., Div. of T. J. Cope, Inc., Collegeville, Pa., to provide an efficient, inexpensive method of supporting a limited number of tubes that often occur in branch runs to and from the main runs of the company's tube supporting system. It comes in 16 ft sections.

The tube race is available in widths of 1, 1½, and 2½ in. and is equipped with tube clips spaced at 2 ft intervals to accommodate ¼ or ⅜ in. tubes. Connections and changes of direction are made by field cutting and welding.

If wider widths of Tube Race are desired, they are supplied with the firm's pin-type coupler that permits connections and bends to be made with standard fittings.

New Motor Line

Lincoln Electric Co., Cleveland 17, Ohio, has announced its re-entry into the electric motor field. The company has introduced a new line of "Linc-Weld" motors which are claimed to represent a major advance in electric motor design through a unique extruded plastic insulation.

The motors, available in standard sizes from 1 to 40 hp, are said to be the first in this range of sizes with extruded plastic insulation. The present line is built in the open type frame and torque design B. They comply with NEMA specifications.

The new thermo-setting plastic insulation, unlike conventional varnish insulation which is applied by dipping, is molded into and around the stator windings. The motor stator is placed into a die and the plastic material is forced into the die under the proper heat and pressure. The liquid plastic resin is extruded through the stator slots, completely covering the stator winding. After the plastic resin sets, the stator is removed from the die.

The company says the plastic, in extensive field test, has demonstrated exceptional resistance to chemical action, humidity, abrasive dust, lint, and oil vapor. In applications that formerly required a totally enclosed frame, the motor has performed much longer than the totally enclosed motor it replaced.

Vacuum Cleaner

Kent Company, 825 Canal St., Rome, N. Y., has added a new commercial vacuum cleaner, the Viking, to its line of industrial cleaners. The new unit, designed especially for light industrial cleaning, is priced to meet the demands of low cost application.

Made for dry pickup, the unit has a capacity of ⅔ bu of dirt. The filter is entirely enclosed and equipped with easy-to-remove paper filters. Power is supplied by a ¾ hp Lamb a-c/d-c motor.

The unit weighs 40 lb and is mounted on four 3-in. ball bearing casters.

CHROMALOX
Electric
TUBULAR HEATERS
provide controlled and dependable conduction, convection or radiant heat

These versatile Chromalox Tubular Heaters provide the kind of heat you need, exactly fitted to your specific heating application.

Available in straight lengths or formed to any desired shape. Used for heating dies, molds, platens; as immersion heaters in liquids, soft metal and molten salts; or in ovens, air ducts and other air heating applications.

Let the Chromalox Sales Engineering staff solve your heating problems . . . electrically

Write for your copy of Catalog 50

—for full information on the complete line of Chromalox Electric Heaters and controls.

For ideas on additional applications of electric heat, request Booklet F1550—"101 Ways to Apply Electric Heat."

Edwin L. Wiegand Company
7646 Thomas Boulevard, Pittsburgh 8, Pennsylvania

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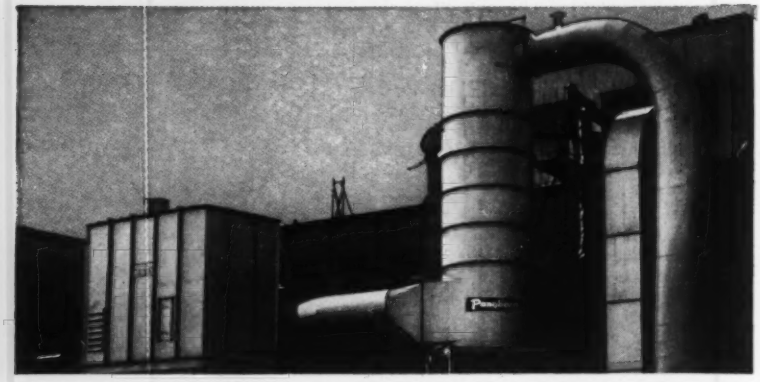
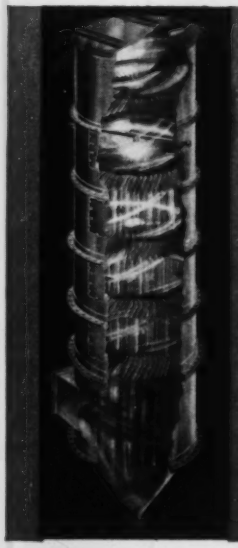
NOW...for efficient wet dust control



FARRELL-CHEEK STEEL CO., Sandusky, Ohio, uses a Pangborn Cloth Screen Collector for dry dust and a new Pangborn Centrifugal Wet Collector for hot and moist dust from shakeout and burning stations. According to Farrell-Cheek, "We are well-pleased with the Pangborn Wet Collector. It does its job efficiently, economically, and we have encountered no maintenance difficulties whatever."

Pangborn Centrifugal Wet Collector



For effective control of hot, moist, inflammable, abrasive, corrosive and obnoxious dust

Effective interaction of air and water explains the efficient performance of this new Centrifugal Wet Dust Collector by Pangborn. Dust-laden air enters the bottom of the collector tangentially and heavy dust particles are immediately precipitated by centrifugal action. Patented vanes cause the air to ascend on a tortuous centrifugal path, exposing it to thorough cleansing by descending water, after which it discharges through the top. Unique Pangborn counter-current design results in greater efficiency of operation, reduced space for rated capacity, lower operation cost through reuse of water and capacity geared to individual needs.

Pangborn CONTROLS DUST

If *your* dust problem involves the control of dust difficult to handle with a dry collector, write for details on the new Pangborn Centrifugal Wet Collector! Send for Bulletin 919 to PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.*

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Welding Insert Rings

Inert-gas tungsten-arc welding of piping without backing rings, smoother root pass welds with elimination of root pass cracking and improved weld contours in thin wall piping with one or two less passes, are benefits claimed for a line of new consumable solid insert rings available from Industrial Piping Div., Grinnell Co., Inc., Providence, R. I.

The company says that on piping of wall thickness over $1/4$ in. the ring assists in obtaining root pass welds of uniform and smooth contours, free of crater and centerline cracks. The completed root pass weld is said to provide an effective back-up for the subsequent shielded metal-arc welding with covered electrodes.

On many sizes, the insert ring also eliminates the need for separately supplied filler metal and the necessity for one or two additional weld passes the firm states.

The rings are produced for all standard or special pipe and tube sizes of diameters $1\,1/2$ in. or larger.

Centrifugal Pumps

A line of centrifugal pumps said to have almost twice the capacities and head pressures of pumps of equal size and horsepower, has been introduced by Bart Laboratories, Div. of Bart Mfg. Corp., 225 Main St., Belleville, N. J. The units are constructed of stainless steel throughout.

Other features include a specially designed close-coupled junction between pump and motor assemblies, and a new "pre-set" two-piece seal.

Flow Counter

A new flow proportional counter, detects and measures all elements down to and including magnesium (#12), is extremely sensitive, has a high counting rate exceeding 60,000 counts per second for soft radiation, and has excellent reproduction qualities, according to an announcement by the Instruments Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

The device is designed for use with the standard Norelco X-ray spectrograph and helium attachment when the latter is required. A special harmless gas flows through the interior of the counter.

When the X-ray beam is surrounded by a helium atmosphere, one side of the counter window is in contact with the special gas and the other side is in contact with helium. Both gases are maintained at pressures that are approximately equal. A specially designed holder permits windows of different thicknesses to be mounted.

The gas which flows through the interior of the counter is a mixture that is purchased in standard high pressure cylinders from commercial gas manufacturers under the company's specifications.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Gage Movement

United States Gauge, Sellersville, Pa., has announced the development of a new movement for their Supergauge and Solfrunt line. This movement, "Arc-loc" is made of stainless steel with a broad nylon-faced stainless steel segment. The Arctang tail provides a single linear adjustment of linkage to the Bourdon tube.

The company says the entire movement can be adjusted around the axis from the rear, and lock screws are so designed that no creeping is experienced in adjustment. According to the company, the movement has been pulsated over 60,000,000 cycles and tested under temperature and humidity variations without binding.

Line Template

A template which enables a draftsman to draw dot and dash lines with a rapid stroke of a pencil or ball-point pen, is a new product of dot-N-dasher, Box 668, Cresskill, N. J.

Produced for making piping drawings, the template is said to be applicable to any type of architectural or mechanical drawing where various broken-line combinations are desired. The template will produce six different lines: long dash, short dash, long dash and dot, short dash and dot, long dash and two dots, and short dash and two dots. The hardness of the pencil determines the density of the line.

It is made of transparent Mylar plastic 0.0075 in. thick. The template is used by placing a straight edge on the desired stencil and drawing the line. Price of the template is $1.25, plus 10¢ for mailing one or more.

Motor Base

A new inexpensive motor base designed to automatically compensate for belt stress and maintain exact belt tension for all load conditions is available from Lovejoy Flexible Coupling Co., 4832 W. Lake St., Chicago 44, Ill.

According to the manufacturer, the new motor base requires no maintenance, and belts can be changed without disturbing the mounting. It is available in four Nema motor frame sizes from $1/6$ to $7\frac{1}{2}$ hp, and is designed for use with horizontally positioned drives. It is not for use on wall or ceiling mountings.

RECOMMENDED

CHAIN DRIVE POSITIONS

Fig. 1

Fig. 2

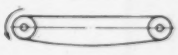


Fig. 3

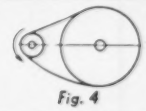


Fig. 4

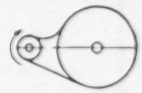


Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

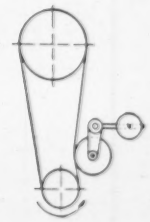


Fig. 10

Illustrated here are several chain drive positions. Figures 1 to 5 are using a horizontal center line and slack strand is preferably on lower side. Figures 6 to 9 are vertical drives. Verticals, if possible, should be placed slightly off the vertical plane. Figures 1 to 4 and 7 and 9 are considered good practice. Idler sprockets as in figure 10 take up chain slack where it is not possible to use adjustable centers. Idler sprockets should be applied against the slack side of chain as near as possible to the fastest moving sprocket.

FREE TEXT! ACME's catalog is filled with chain facts, valuable data and tables that enlighten and save you time. Full table of sizes, strengths and list prices of cable and roller chain included. FREE upon request to engineers and designers. Write ACME CHAIN CORP., Dept. 11C, Holyoke, Mass.

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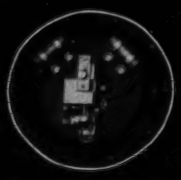


MERCOID
DIAPHRAGM CONTROL
FOR LOW PRESSURES

HAS HERMETICALLY SEALED MAGNETIC MERCURY SWITCH

Here's a diaphragm operated pressure control for use on low pressure applications where the control is required to operate from changes of fractions of inches of water (pressure). It has many applications such as for operating from changes in draft conditions (either forced or induced;) to operate from slight changes in head pressure; for high or low alarm devices on air or gas lines.

OPERATING RANGES—six ranges available from 0-1" pressure to 1-30" vacuum with sensitivities varying from .01" pressure to 0.2" vacuum depending upon range selected.

CIRCUIT ARRANGEMENTS—several models available to accomplish the following operations:

SPST—USING ONE MAGNETIC SWITCH—"switch contact opens on increase of pressure or switch contact closes on increase of pressure."

STAGE OPERATION—SPST USING TWO MAGNETIC SWITCHES—"open both switch contacts on increase of pressure"; "close both switch contacts on increase of pressure"; "close one switch on increase another on decrease"; "open one switch on increase another on decrease".

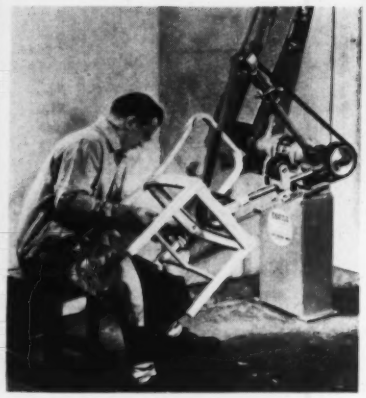
CASE STYLES—three types to meet following conditions: Indoor (general purpose), Outdoor (weather resistant), and Hazardous Locations (explosion proof).

WRITE FOR BULLETIN No. 13

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

Manufacturers of controls for pressure, temperature, liquid level, float, mechanical operation, etc. All equipped with hermetically sealed mercury contacts.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS



Abrasive Machine

Curtis Machine Corp., Jamestown, N. Y., has announced the manufacture of Model DBA-1F Flex-A-Belt, a machine on which it is claimed to be possible to perform any of the basic abrasive belt applications found in a grinding, polishing or deburring department.

The extension arm assembly can be rotated 360 deg on the motor hub. The illustration shows a grinding or polishing operation on a hard-to-get-at area with interference-free idler contact roll. The company says the following operations can also be performed: formed contact wheel grinding operation on a contoured piece; slack belt polishing or deburring application; direct contact wheel grinding operation with a work rest; flat grinding application on a platen.

The unit has a totally enclosed motor, sealed ball bearings, automatic spring loaded belt tensioning and positive belt tracking. It is a double end motor unit and is available in three varieties: with two arms; with one arm and one standard contact wheel grinding arm; with one arm and one side of the motor open for grinding wheel, buff or brush application.

Welding Process

What is said to be the first complete semi-automatic hand gun welding process designed specifically for use with carbon dioxide is announced by Welding Products Div., A. O. Smith Corp., Box 584, Milwaukee 1, Wis.

The process uses CO_2 gas to shield the arc. This compact, portable process contains a hand gun, control unit and a special 600 amp d-c power source. The process was designed to fill the need for a welder that offers the welding speed advantages of fully-automatic operation without the related high jig fixture tooling costs.

The firm points out that CO_2 costs approximately one cent a cubic foot compared with almost seven cents for helium and nine cents for argon, the generally-used gases. The CO_2 process is intended for use on mild or carbon steel welding applications, wherever a high degree of automatism is desirable.

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FLIGHT TESTING
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RESEARCH
Computer Engrs-Digital or Analog
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Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify.

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GRUMMAN AIRCRAFT
Engineering Corp.
Bethpage, N. Y.

LAST CALL

Be sure your company takes advantage of the FREE PRODUCT LISTINGS in the directory section of the 1957 MECHANICAL CATALOG

The editors of Mechanical Catalog are expanding and improving the directory section to make it of even greater service to you ... of even greater value to manufacturers of products used and bought by mechanical engineers in industry.

Listing guides have been sent to 4,500 companies to enable them to conveniently check off products they wish listed in this valuable reference book. Your company has received one of the guides. If it has not been returned to us, you'll do your company and the Society a great favor by expediting its return. If your company has not received a free product listing guide, drop us a line and we'll forward one immediately. By all means, be sure your company's products are listed in the directory section of the 1957 MC.

MECHANICAL CATALOG

Published annually as a service for members by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street New York 18, N. Y.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Immersion Heater

A single-unit immersion Heater-Thermostat, prewired and ready to be connected into any available circuit, has been introduced by N. J. Thermex Co., Inc., 533 Bergen St., Harrison, N. J.

According to company, the heater is ideal for use in both small plating tanks and in an independent series in large tank installations. In large-area tanks, individual portable units assure uniform heat distribution and control and elimination of expensive relay switches. Worn-out elements are easy to replace, the company says.

Pure, fused quartz sheathes the sensing bulb. For cyanides and caustic solutions, the immersion heater-thermostat combination is made of stainless steel. In applications where rough usage may damage the heater sheath, the firm supplies chemical-resistant perforated protective tubing as additional equipment.

Maximum capacity of the heater thermostat unit is 6000 watts. The unit is equipped with a dial control which may be set for standard temperature at the desired operating range (from 50 to 250 F).

Idling Control

An idling control that reduces the engine to idling speed with a flick of a lever is a feature of a new 2500-watt direct-drive engine-generator announced by Wincharger Corp. of Sioux City, Iowa.

Purpose of the new idling development is to conserve fuel, extend engine life, and lower maintenance cost, according to the company.

Additional optional features stressed by the company include the light weight, a king-sized generator designed to give unusually close, steady voltage regulation, and an indicator pilot light. Also available as optional equipment are a 2-wheeled dolly, and a retractable starter.

Tube Fitting

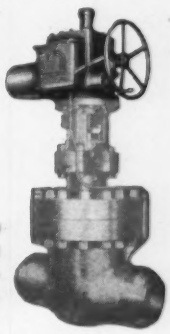
Weatherhead Co., Fort Wayne Div., Fort Wayne, Ind., announces a new low-cost self-aligning tube fitting under the trade name Selfalign.

The company says a major advantage of the new fitting is that it can be installed without disassembling. The tubing is simply inserted in the fitting until it bottoms and the nut is tightened. The dual sealing principle is said to assure positive, leakproof connections. The sleeve grips the tubing over a broad area for a surface-to-surface seal, while a thin razor edge and guiding shoulder form a line-to-line seal with the tubing as the nut is tightened.

The new fitting is suited for instrumentation and all other low- and medium-pressure applications using copper and aluminum tubing, the firm says. The complete line includes union, union tee, union elbow, male and female connectors, male and female elbows, male tees for pipe on run and pipe on branch.

Check these features

- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight, watertight and explosion-proof construction.
- Hammerblow device . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96" diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.



Send for Catalog L-550 and see why this and other types of LimiTorque Valve Operators are so widely used.

LimiTorque®

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FLUID AGITATORS - FLEXIBLE COUPLINGS

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When product designs for welded steel

Have twice the rigidty... three times the strength

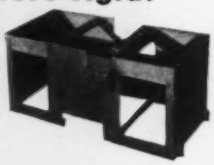
Yet require less material ...cost less to fabricate

WHY

aren't all your products designed for welding?

THE BETTER WAY
40% more rigid!

. . . yet this machine base of welded steel costs half as much as former cast iron designs.



Ask

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio

The World's Largest Manufacturer of Arc Welding Equipment

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Bore Gage Setter

An adjustable setting master for dial bore gages is offered by Standard Gage Co. Inc., Poughkeepsie, N. Y. The unit is set by means of gage blocks to any desired dimension between 1 and $12^1/_8$ in. and thereafter serves for the initial setting or subsequent reference of a dial bore gage. It can be successively reset to a number of different dimensions within its range.

The firm says a combination of requirements is met by the swivelling column which locks in either of two positions. While setting the unit it is necessary to keep the weight of the gage blocks off the adjustable anvil and while setting or checking the dial bore gage the weight of the gage itself must be kept off its movable plunger and centralizers. It is thus set with its adjustable anvil uppermost, clamped in the set position, and then the column is rotated 180 deg to bring the centralizing yoke on top.

Solenoid Valve

A four-way solenoid valve, produced for the control of air, water and light oil to 150 psi, designed to conform to JIC specifications, has been announced by Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif.

The solenoid is inoperative when its cover is removed, and there is a manual override which is safe against accidental actuation. The conduit connector is threaded and the pressure ring terminals are on 6-in. free leads. The solenoid and the junction box are protected by captive cover plates secured by captive screws. The valve can be removed from the sub base by loosening three body clamps.

According to the company, the new valve also has the features of its standard Crescent valves. Pressure drop is reduced because the free port area approximates the pipe area. The JIC solenoid is interchangeable with standard solenoids. The valve can be converted to any practical current or voltage by a coil change.

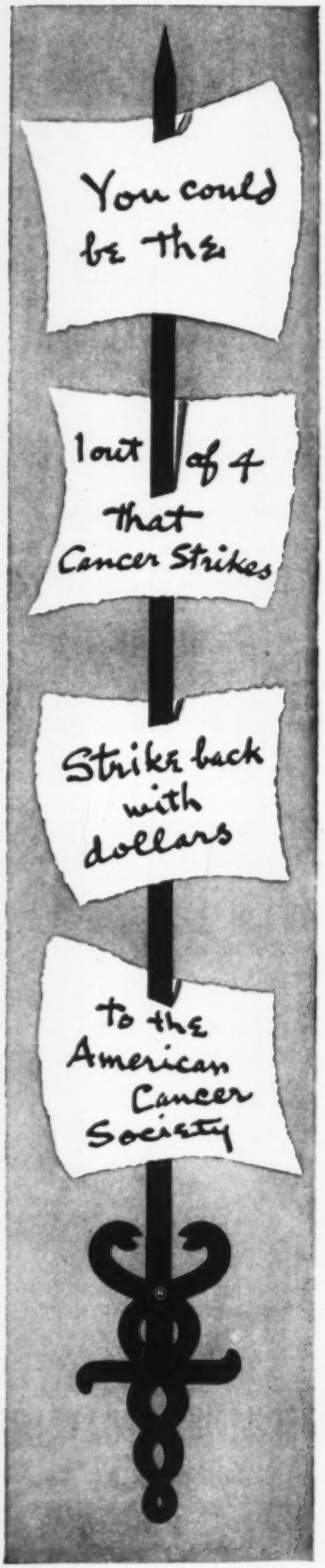
Heat Interchangers

Heat-X, Inc., Brewster, N. Y., has introduced a line of 'SRX' superheater-heat interchangers designed for use on air conditioning and refrigeration systems to insure full utilization of the evaporator surface and eliminate having part of the surface being used for superheating the refrigerant.

The units combine a superheater with a heat exchanger featuring patented inner-fin construction which is said to provide maximum heat transfer with minimum pressure drop.

According to the company, the units subcool the liquid refrigerant, thereby improving expansion valve operation and increasing the efficiency of the evaporator due to the reduction in the amount of flash gas.

Complete specifications on the units, available in capacities from 1 through 100 tons, are contained in a descriptive bulletin.



KEEP INFORMED

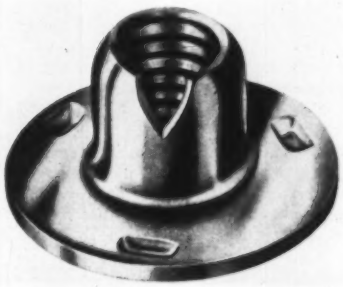
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Wire Braid Hose

A new wire braid hose with a specially-compounded, white neoprene grease- and fatty oil-resistant cover has been added to the line of hoses produced by Hamilton Rubber Mfg. Co., Trenton, N. J.

Designated Revelation wash up hose, the product was developed for maximum flexibility under the high pressure hot water and steam conditions and service requirements of fish canneries, meat packing houses, dairies and food processing plants.

The inner tube is made of a heat-resisting compound. A high tensile steel wire braid reinforced carcass prevents the hose from bursting or ruptures. The hose is available in ID's of $\frac{1}{2}$, $\frac{3}{4}$ and 1 in. and will handle saturated steam to 150 psi.



Vibration Resistant Nuts

Carr Fastener Co., Div. United-Carr Fastener Corp., Cambridge 2, Mass., announces a re-usable, prevailing torque type, self-locking nut which incorporates a V-type notch. The circumference of the barrel compressed inwardly toward the axis forms a permanent set.

The self-locking device is an integral part of the design of the one-piece nut, the company says. The unit, called Teenut, is said to be resistant to heat and oils and has high tensile strength. The firm points out that the nut does not rely on base load to obtain its friction grip. It may also be used as a stop nut.

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Manzel Force Feed Lubricators insure efficient machinery operation by lubricating automatically. No stops for hand oiling — or because of breakdowns caused by faulty lubrication. They

quickly pay for themselves through savings in down time, labor and lubricants.

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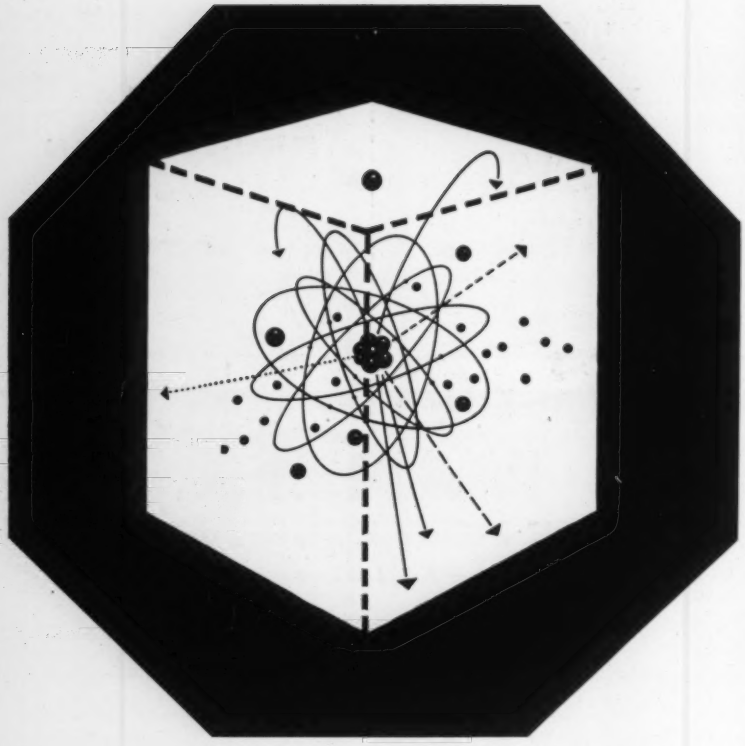


power in the small economy size

Harnessing the atom with the development of transportable nuclear power is probably the greatest of all impending events.

Today, a top Martin team of scientists and engineers is attacking that problem. Their goal: development within two years of a fully integrated system of portable power for military and industrial uses.

Already forseeable is a reactor capable of delivering 2,000 kw for a year and a half from a single fuel bundle occupying less than 8 cubic feet of space.

Such an advancement may soon usher in a new age of power surpassing even the ages of steam and electricity in hastening the development of this world's unexplored resources.

This immense field of research and development offers one of the great engineering opportunities in the world today. If you are interested, contact J. M. Hollyday, Dept. ME-05, The Martin Company, Baltimore 3, Maryland.

MARTIN
BALTIMORE

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Gas Truck

Yale & Towne Mfg. Co., 11,000 Roosevelt Blvd., Philadelphia 15, Pa., has announced the development of what is described as industry's first GS approved gas powered industrial lift truck for safe use in hazardous locations.

The company says it is the first lift truck manufacturer to introduce a truck which fully complies with the stringent regulations for GS approval as set down by Underwriters Laboratories. The approval covers Yale's gas-powered trucks in capacities from 3000 to 10,000 lb.

According to specifications and recommendations prescribed by the National Fire Protective Association, GS trucks are the only gasoline trucks which can be safely used in locations defined as hazardous because of the presence of combustible fibers or flyings or hazardous gases and liquids being stored and handled in closed containers.

The new GS trucks fit the safe usage requirements spelled out for locations listed in the code in parts of Class I, Division II and Class II, Division II, and all of Class III, Division II in the National Electric Code.

Control Valves

A two-way Flo-Control valve which is adaptable to either straight or angle installation has been announced by Bell & Gossett Co., Morton Grove, Ill. The valves are used to prevent gravity circulation in a forced hot water heating system when the booster pump is not in operation.

Designed to reduce the amount of inventory needed for this type of valve, they are available in the 1, $1\frac{1}{4}$ and $1\frac{1}{2}$ in. sizes and replace the individual straight or angle pattern valves of the same size.

A new product circular describing the company's line of valves has also been released.

Use a CLASSIFIED ADVERTISEMENT
for Quick Results

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Low Hydrogen Electrode

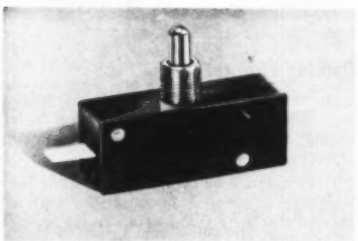
A new powdered metal, low hydrogen electrode, said to be faster in lineal speed by up to 30 per cent than conventional low-hydrogen electrodes, has been announced by General Electric Company's Welding Dept., Schenectady 5, N. Y.

Designated Strikeasy LH-2, the new electrode is a gray, heavy coated, low-hydrogen electrode with powdered metal added to the coating. It meets the mechanical requirements of AWS Class E-7016.

The company says the electrode has been successfully field tested by manufacturers of heavy machinery, materials handling equipment, and large turbines.

The new electrode is faster than conventional low-hydrogen electrodes because of a higher desposition rate, reduced slag cleaning time and spatter loss, according to the company. The result is an increase of up to 30 per cent in lineal speeds, the company says.

Recommended for use with d-c reverse current, the electrode can also be used with a-c current. Ultimate tensile strength, as welded, is rated at 80–83,000 psi, yield strength at 70–73,000 psi with elongation of 34 per cent in a 2-in. specimen. Impact tests indicate that the deposit, as welded, undergoes a transition from ductile to brittle fracture below −40 F, according to the company.



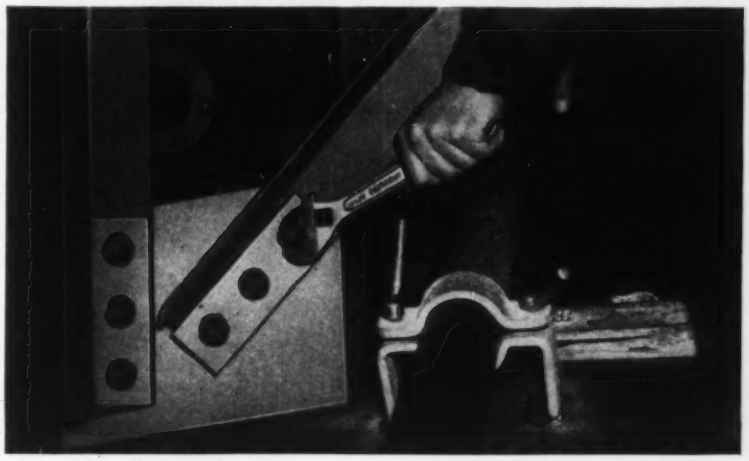
Switching Mechanism

An improved switching mechanism said to provide longer life has been incorporated into the line of standard Snapac switches manufactured by Soreng Div., Controls Corp. of America, 9555 Soreng Ave., Schiller Park, Ill.

Model 750, panel mounting switch has a total travel of 1/4 to 3/8 in., and is recommended by the company where the actuating motion cannot accurately be controlled. This model has high current capacity for direct control of a circuit and is listed by Underwriter's Laboratory for 15 amp, 125 volts a-c, 10 amp, 250 volts a-c, 1/2 hp, 125/250 volts a-c rating.

Available circuits include SPST normally open or closed and SPDT. The company says the unit's construction makes it adaptable for door switch, push button switch or limit, safety interlocking and control applications.

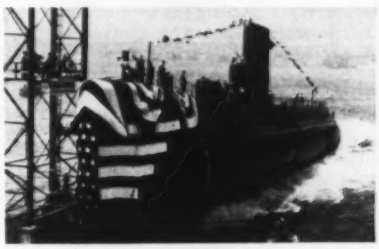
FASTENER PROBLEM



Fasteners to resist high undersea pressure, vibration, corrosion and wet-dry cycles

In building the world's first atomic powered vehicles, the submarines Nautilus and Seawolf, the Electric Boat Division of General Dynamics Corporation, Groton, Connecticut, faced many unique problems. One was the specification of the best fastener to join the superstructure of the sub to the hull. This construction had to be able to withstand the vibration and shock of rough weather surface operations, the corrosive action of sea water and salt atmospheres and the unending wet-dry cycles incidental to regular submarine duty.

Stainless steel Elastic Stop® nuts with nylon inserts were finally chosen as the best answer to these multiple requirements. The locking action of ESNA's familiar red collar holds the superstructure joints firm despite the most extreme conditions of this application. The inserts provide extra corrosion protection for internal bolt threads, in addition to insuring positive, vibration-proof holding power. Alternating conditions of total immersion during dives and exposure to air during surface runs do not impair their efficiency.



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Look to ESNA for the most practical answer to your most difficult fastener problem.

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Please send me the following free fastening information:

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☐ Here is a drawing of our product. What self-locking fastener would you suggest?

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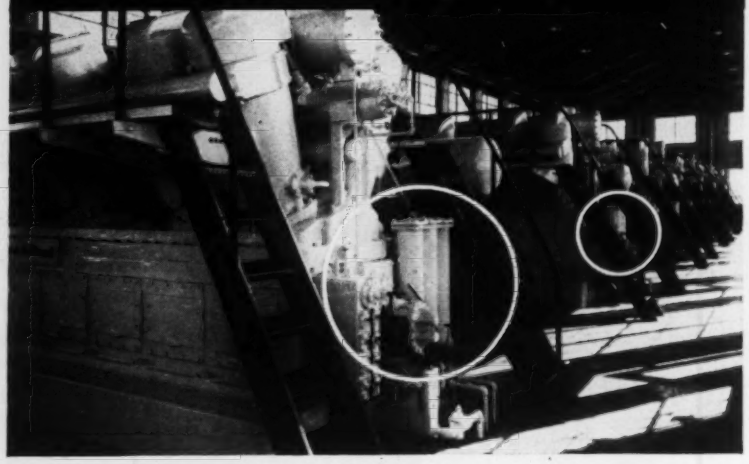

. . . TOP ENGINE EFFICIENCY

● Shown above is a view of six Ingersoll-Rand, 1320 h.p. gas engine compressors installed for service at United Gas Pipe Line Corporation's Needville (Tex.) station.

And here's top recommendation. All 6 powerful units feature the surest and most reliable filtration units available . . . NUGENT LUBE OIL FILTERS!

These mighty I-R units are used to boost gas to 900 PSIG discharge pressure on a new 30″ line. Nugent Filters present the engine's first line of defense. They keep the lubricating systems free from harmful impurities because Nugent filter elements are designed to *catch practically everything!* By providing 20 times more filtering area than other filters of comparable size, Nugent Filters make possible greater filtering *action* and *more effective* filtration to insure longer engine life. Filters of the above type are easy to install . . . require no intricate piping . . . operate flawlessly and work perfectly in conjunction with any engine's overall lubricating system. They are available in full flow or by-pass with the same unit.

You can see low cost, dependable Nugent Filters on expensive machinery everywhere. Expensive machinery? We mean big or small diesel engines, gas engines, turbines, compressors, etc. On such equipment, manufacturers select and install, AS ORIGINAL EQUIPMENT, Nugent Filters. If you have a filtering problem, follow this advice—GET the surest, most effective filtration your dollars can buy. GET Nugent Filters for TOP engine performance. Write for full information.

Nugent Duplex Oil Filter. These filters are also available in Triplex Models.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Micrometer Tester

A master gage set of unique pyramid design for testing the accuracy of shop micrometers has been introduced by Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.

Called the Mikemaster by the manufacturer, the instrument consists of six lapped, hardened, and normalized steel cylinders graduated in size from 1 to 6 in. in diameter. To check his micrometer an operator slips it over one of the cylinders to see if the micrometer reading agrees with the cylinder size. If the readings are correct, the instrument is accurate.

The cylinders, pyramided one atop the other, are permanently attached to a wooden base, made to Class Y accuracy, and calibrated to four decimal places.

Cooling Towers

Acme Industries, Inc., Jackson, Mich., has announced a new line of Flow-Mizer cooling towers in capacities from 15 through 100 tons.

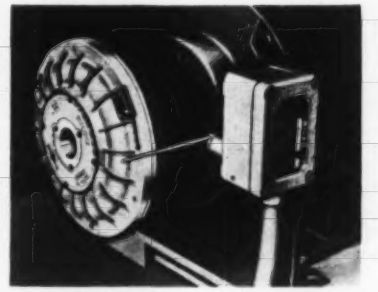
According to the company, features of the line include stepped-up capacities and increased efficiency through incorporation of a new advanced-design Acme-Pak, which consists of a series of vertically mounted steel plates said to create ideal conditions for water evaporation and fast, efficient heat dissipation. This is accomplished by the extremely large area of water film present on the plates and the direct, unimpeded flow of air blowing between them. The result, the company says, is maximum water-cooling capacity per cubic foot of tower. Wide spacing of the plates is designed to hold sedimentation and scale build-up to a minimum.

Centrifugal blowers provide quiet, constant-velocity air flow with ample capacity for use with ductwork, when needed. The blower section has outlets set at 45 deg angle to allow discharge in any direction.

For Consulting Engineers Turn to Page 162

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Thermal Cutout

Protection against overheating of Flexidyne, a dry fluid drive, is provided by a thermal cutout announced by Dodge Mfg. Corp., Mishawaka, Ind.

Instantaneous mechanical overload protection is inherent in the drive, the company says. Now, if an overload causes prolonged slipping and consequent heating, the thermal cutout trips the switch, cutting off the power and, if desired, giving an alarm.

The new cutout is recommended especially by the company for all unattended installations. This device is said to be easy to mount on the side of the drive. It contains a trigger spring, held down by an alloy thermal pin. Before the Flexidyne can heat up enough to cause any damage, the thermal pin will melt, allowing the trigger to spring out so that it will push the non-sparking striker of the special switch to the "off" position.

The unit is reset by removing one screw, pushing back the trigger and inserting a new thermal pin, and then re-attaching to the drive with the single screw.

Valve attachment

A new power-centered neutral attachment for all the firm's double solenoid Speed King valves, providing full control of double-acting cylinders and similar devices, is announced by Valvair Corp., 454 Morgan Ave., Akron 11, Ohio.

The new attachment, which consists of stop plungers in extensions mounted at the ends of the valve body, uses air power to provide positive mechanical centering of the main valve stem in neutral position. Completely self-contained within the valve assembly, the power-centered neutral operates without the use of mechanical springs on the main valve stem. The company says that because it provides a positive mechanical stop at neutral and has no springs to weaken or break, the new attachment will not allow the main valve stem to drift out of neutral. Absence of springs also allows power-centered neutral-equipped valves to be mounted in any position. Teflon shock pads in valve end caps cushion stem and stop plunger travel.

The new power-centered neutral attachment may be installed on double solenoid valves now in service, as well as on new valves.

ATOMIC AGE FUTURES

FOR CREATIVE ENGINEERS

Today, there are innumerable openings for engineers. But, if you are an ambitious, creative technical man, you want more than just a job. You want *opportunity* — an opportunity to build a real future.

At Pratt & Whitney Aircraft, we are doing work on an atomic engine for aircraft. The degree of progress is classified, however, you may be sure that there are still challenging problems where you can demonstrate your creative abilities.

Ours is a progressive organization — quick to recognize and reward professional achievement. Thus, if you can qualify, you will have a rare opportunity to build toward a fine future in this new engineering field.

If you are looking toward "tomorrow" — send your complete resume immediately to Mr. P. R. Smith, Office 14, Employment Department.

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Due to our continuing expansion program, a number of top grade openings exist in our new laboratories suburban to Washington, D.C. We urge you to consider the following:

1. At Melpar the engineer is not tied to a pre-arranged schedule of advancement. Instead, promotion and advancement are based on *individual recognition*, where skill and ability are the paramount factors of determination.

2. Melpar has doubled in size every 18 months for the past 10 years. New openings occur constantly. This enables the engineer to advance to positions of increased responsibility *as soon as he is ready.*

3. Our unique "project team" basis of organization gives the engineer an opportunity to participate in *entire* problems from conception to completion of prototype, and thus experience the "over-all" approach to engineering problems necessary to eventual directorship responsibility.

4. Our new air-conditioned laboratories encompass over 285,000 square feet and offer *complete* facilities for creative research and design. In addition to our central Model Shop, supplementary facilities, personnel and test equipment are available for *immediate* use within each project group.

5. The Northern Virginia Area, suburban to Washington, D. C., in which Melpar is located, offers excellent living conditions, enjoys the Nation's highest per capita income, fine homes and schools. Recreational, cultural and educational facilities abound. Fully-accredited graduate courses are offered at the Melpar laboratories and at 5 universities in the Area.

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Write for complete information. Qualified engineers and physicists will be invited to visit Melpar at Company expense.

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

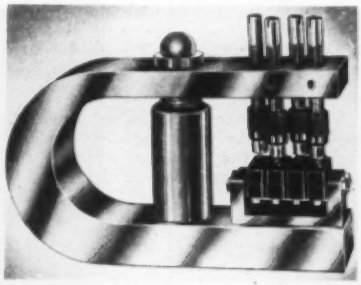
Multiple Drive System

A drive system of synchronized variable speed, multiple drives has been developed by U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles, Calif. It is designated U. S. Varidyne.

The heart of the system is a specially designed power unit which interlocks motors by means of electrical impulses. According to the company, turning the control dial on the power unit varies the speed of every motor in the system equally and simultaneously. The motors are of the a-c, squirrel-cage induction type, connected to the power unit by means of standard 3-phase circuitry.

The system is said to be easy to install and affords a practically unlimited selection of motor types. Enclosures available include drip-proof, totally-enclosed and explosion-proof designs. Speeds of from 1 to 10,000 rpm are available in ratios of up to 5.1, and higher speed ratios can be supplied. Motors can be furnished from $^1/_3$ to 25 hp at maximum rpm. Power units are available to carry from 1 to 50 hp connected load.

When the motors are operating in tandem, as on a single conveyor, they will equally share the load. This factor is claimed to eliminate damage from extreme overloads at any one point on the conveyor.



Mechanical Force Gage

W. C. Dillon & Co., Inc., 14620 Keswick St., Van Noyes, Calif., has introduced a multi-switch force gage in 11 different capacities with from one to four control switches. The unit is designed for controlling mechanical forces at various load points.

Basic design of the unit centers around an alloy steel pressure beam made in the shape of a U. A yoke in which the switches are set is mounted on the lower leg of this beam. When load is applied across the center of the beam, it deflects inwardly, causing the finely threaded adjustment screws in the upper half of the bar to contact the switches. On a four switch model, each switch can be set to function at a different load point within the range of the instrument, or all switches can be made to function at the same load.

Available capacities are 0–10 lb; 0–25 lb; 0–50 lb; 0–100 lb; 0–250 lb; 0–500 lb; 0–1000 lb; 0–2500 lb; 0–5000 lb; 0–10,000 lb; 0–50,000 lb.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Low Deaerator

A new low-head-room deaerator with standard capacities up to 80,000 lb per hr is announced by the Deaerator Sect., Steam Power Dept., Worthington Corp.

According to the company, the new line is particularly applicable in boiler rooms of office buildings, schools, hospitals, and modern single story industrial plants where head room is normally limited. The standard design comprises four sizes up to 80,000 lb per hr capacities. Larger capacities in the same design will be fabricated on request.

The new patented design consists of the standard steam-jet deaerator with a pump mounted below, forming part of the entire unit. Pump suction is connected to a large down comer which is equipped with an anti-vortex baffle and strainer. The high suction characteristics provided by this arrangement increase the pressure of water leaving the deaerator to the pressure required at suction of the boiler feed pump. This design eliminates the necessity of elevating the deaerator above the boiler feed pump and thereby reduces costly supporting structures and piping arrangements.

The company says use of its patented deaerator recirculation design prevents the pump from becoming vapor bound and provides maximum deaeration under abnormal operation.

The new design permits the recirculation of stored water through the deaerator. This operation heats the water and removes the oxygen before the water is fed to the boiler.

Extrusion Press

Sutton Engineering Company, Pittsburgh, Pa., has announced a new 1250/1500-ton aluminum extrusion press. Featured is a completely new electro-hydraulic control system which the company says is now being used for the first time in any extrusion press.

Demonstrations of actual extrusions of aluminum shapes are now being made at the Sutton plant at Bellefonte, Pa.

Control Valves

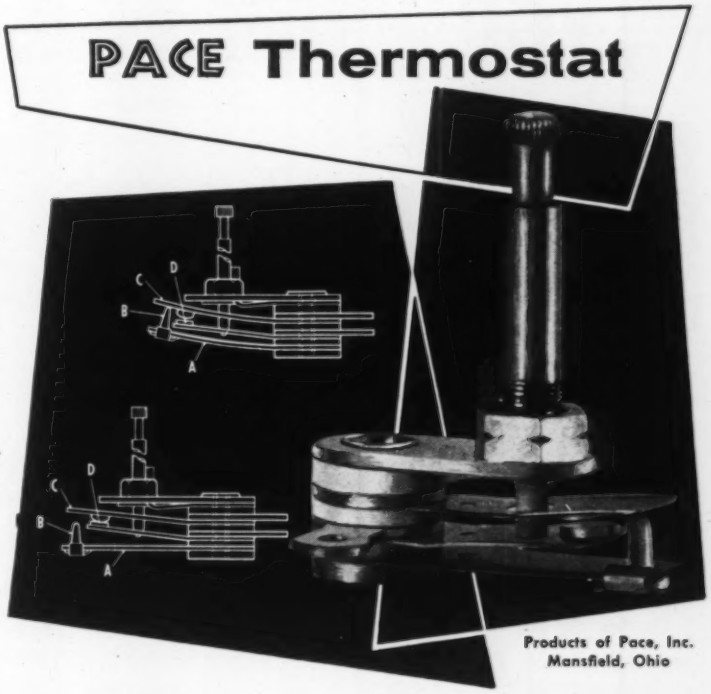
An improved version of the firm's standard Type D pressure reducing and regulating valve for liquids, steam and gases has been introduced by the A. W. Cash Co., Box 551, Decatur, Ill.

According to the company, improvements include 50 per cent reduction in the number of flange bolts and introduction of a gasket seal at the diaphragm flange. Features retained from the former model include interchangeable internal working unit, easily accessible interior, construction with minimum of parts, and built-in strainer.

The new valve is available in iron, bronze, steel or stainless steel body, and bronze, stainless steel, nitralloy or monel trim. Screwed ends are from $\frac{1}{4}$ to 2 in.

How Chace Thermostatic Bimetal actuates the

PACE Thermostat



Products of Pace, Inc.
Mansfield, Ohio

Pace, Inc. manufactures a full line of positive make and break thermostats having an operating range from 100°F. to 650°F., with differentials from ½ to 8 degrees F.

Their special design incorporates a steatite adjusting pin which eliminates wear and lost motion from repeated adjustments which may often cause jump and drift in calibration. A positive locking clip of stainless steel holds bumper button tightly to bimetal blade at all operating temperatures to prevent creep and frying of contacts. All parts are protected for maximum resistance to corrosion and are enclosed in plastic envelopes for shipment and storage.

How it works—In a normally closed circuit position, ambient temperatures in excess of the thermostat's calibrated rating cause the sensitive Chace Thermostatic Bimetal element (A) to deflect upward so that bumper button (B) bears on contact blade (C) opening circuits at silver contacts (D). Circuit is automatically closed when temperature is again normalized.

Chace Thermostatic Bimetal is available in 29 types, in strip, in coil or in complete elements made to customer specification. Write for our brand new, fact-filled 44-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing interesting uses of bimetal, formulas, calculations, etc.

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Thermostatic Bimetal
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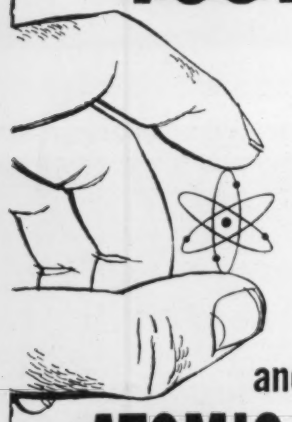

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Micrometer Depth Gage

A new micrometer depth gage with a graduated base is announced by Lufkin Rule Co., Saginaw, Mich. Depth of holes, slots, projections are measured with micrometer accuracy with the gage, the company claims. The base is graduated on one side to permit taking measurements at a specified distance from the edge of the work.

Graduations are in 50ths and extend 2.4 in. both sides of zero located in the exact center of base. It is available in ranges of 3 and 6 in. with lock nut or with lock nut and ratchet.

Evaporative Condensers

Acme Industries, Inc., Jackson, Mich., has announced a new line of Flow-Mizer evaporative condensers, capacities from 20 through 150 tons at 75 deg wet bulb.

An advanced design blower section has air outlets on a 45 deg angle that allow any direction of air discharge. The company says the construction allows economical installation of ducts, when required, with centrifugal blowers furnishing ample power to offset ductwork static pressures.

A new simplified external sump is designed to simplify water treatment, servicing of sediment screen and draining of the unit. Immediately accessible when the sump lid is lifted is a patented, combination bleed-off, drain and overflow stand-pipe. The stand-pipe prevents accidental overflow and slips out of drain connection for draining sump water during cold weather shut-downs.

Full access to the drift eliminators, nozzles and condenser tubes is made possible in the new design.

Balancing Machine

Raydyne Corp., 920 W. Laurel St., Springfield, Ill., announces its new "Mogul" balancing machine which is said to reduce complex balancing operations to the absolute in mechanical simplicity. Pedestal type design permits units to be placed together or separated according to the length of the piece to be balanced.

The firm says the resulting, almost unlimited field of balance is adaptable to the shortest rotors or the longest type of paper mill roll. The drive unit may be positioned at either end or in the center, as individual requirements indicate. When not in use, the pedestal-units may be pushed together and the machine will require only the combined width of pedestal-units in floor space.

To locate and measure conditions of unbalance, the unit employs a true seismic free-in-space unbalance indicator attached to work-supporting mountings on chrome balls and raceways which provide more than four in. of free amplitude travel. In addition to the weight loads this type of design permits, its use in combination with variable speed power drives enables the operator to correct large amounts of unbalance at low, safe speeds, the company says.

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ME-5

KEEP INFORMED | NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Drill Press

An electro-magnetic drill press, said to embody both easy portability with drill press accuracy, has been announced by Portomag, Inc., 1511 E. Nine Mile Rd., Ferndale 20, Mich.

Its heavy duty electro-magnetic base makes it possible to affix the power drill right to the surface of a job, the company says. For operating accuracy, regardless of working position, the burden of drill weight is spared the operator.

Special features of tool include a three-way power control switch enabling the operator to vary the holding power in the electro-magnetic base. The switch allows for a reduction in power sufficient to hold weight of unit against working surface yet allowing for movement for positioning to center punch mark. Full power position will hold the unit securely for accurate drilling work. The press has a power capacity of 1400 to 1900 lb for positive positioning, a demagnetizing switch for immediate removal from work, and an optional reversing switch for tapping operations.

Miniature Indicator

A new, hermetically sealed miniature indicator featuring high readability, extremely small size, and excellent vibration resistance has been introduced by Marion Electrical Instrument Co., Grenier Field, Manchester, N. H.

A unique rotating disk dial allows maximum display area of colored flags in quadrant type mask openings of 90 deg or less. This makes possible a confusion-proof presentation of alarm, malfunction, position, or other information, the company says. The unit is called "Mindicator" by the company. It has a face diameter of $^{3}/_{4}$ in., body diameter of $^{13}/_{16}$ in. and over-all front-to-back depth of $1\,^{17}/_{64}$ in. The company says the unit may be used with existing instruments lacking such displays, and with one or more devices requiring single or multiple answers.

The "Mindicator" meets the vibration requirements of MIL-E-5272A Procedure I, the company says. It is available in all sensitivities normal to moving coil d-c instruments. A pointer type is also available.

O-Ring Seals

O-ring seals molded from a new synthetic rubber compound developed especially for fuel oil service are offered by Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

The new material is designated Compound 37-751. It has Underwriters Laboratory approval for use with fuel oils, having undergone exacting tests with six different fuel oils, the firm says.

BUSINESS NOTES

Move Sales Office

Leeds and Northrup of Philadelphia, will move its New York district sales office from 60 East 42nd St., to William Kaufman's new building at 711 Third Avenue. The company has taken a large part of the 16th floor tower of the new structure.

Appoints New Agents

A. W. Cash Co., Decatur, Ill., has announced the appointment of two new agents for the Cash Standard line of automatic valves, controllers, governors and regulators. They will also represent the Cash Standard Stacon Corp., a subsidiary for temperature regulators.

Representing the firm in the western two-thirds of Tennessee and northeastern quarter of Arkansas is Hurston-Conaway, Inc., with main offices at 2470 Poplar Ave., Memphis and sub-offices at Nashville and Little Rock. Representative for the state of Utah is Thermal Engineering Co., P. O. Box 446, Salt Lake City 10, Utah.

In New Building

All the Bellows Co. west coast activities are now consolidated in a new building erected by the company at 926 Western Ave., Glendale, Calif. The new building will serve as headquarters both for The Bellows Co. of California, and the Smith Johnson manufacturing division of the company. The firm manufactures air cylinders and other pneumatic work devices.

West Coast Office

Construction on a new Los Angeles engineering and sales office for the Liquidometer Corp., Long Island City, N. Y., is expected to be completed in September of this year.

The new one-story building at Santa Monica Blvd. and Packer Ave. will have 4500 sq ft of floor space and will be completely air conditioned. Liquidometer will equip the plant for overhaul and repair of its line of industrial and aircraft liquid gaging instruments.

The Value of RELIABLE DELIVERIES

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Any job involving a large amount of responsibility is exacting. While I do not claim that mine is the toughest, I can say that the rigid policy set down by our management requires constant diligence and effort.

It is the policy of The Cincinnati Gear Company to make a delivery promise to the customer that there is every reason to expect will be fulfilled. The customer has a right to receive accurate information concerning the anticipated shipment of his order, and he also has a right to expect that promise to be fulfilled. It is the job of my department to operate our *new production scheduling system* in such a manner that accurate delivery promises can be given, and at the same time prevent the lead time from being ridiculously long. It is gratifying to state that we have failed to meet schedules only in a very limited number of instances, and many times have been successful in helping customers who, for some reason or another, found themselves in a real jam.

The management of The Cincinnati Gear Company has charged me with the responsibility for deliveries. I know there will be no compromise short of the best possible job, and I can assure you that the most meticulous plannning is done to be certain that delivery promises will be met.

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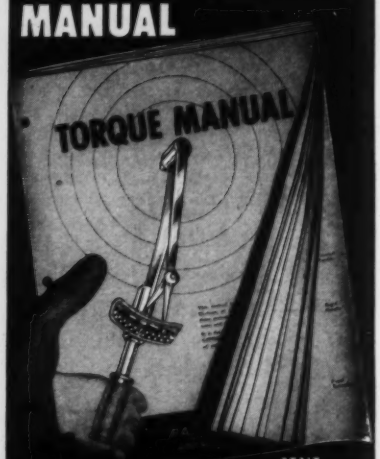

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

New Headquarters

Ground-breaking for the new headquarters for Ledeen, Inc., manufacturer of pneumatic and hydraulic cylinder valves, actuators, pumps and special equipment, has taken place at 3350 N. Gilman Rd., El Monte, Calif. The new plant will also serve as headquarters for Engineering Products Co., a subsidiary, distributing mechanical power transmission and materials handling equipment.

Opens Western Office

M. W. Kellogg Co., engineering-construction firm for the chemical and petroleum industries, has announced the establishment of a western regional office with headquarters in San Francisco's Russ Bldg. Kellogg is a subsidiary of Pullman Incorporated.

LATEST CATALOGS

D-C Power Supply

A bulletin describing the Model MR2432-100XA, 24 to 32 volt 100 ampere magnetic amplifier regulated d-c power supply is available from Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

The unit has an Input Voltage of 208, 230, or 460 volts and an output voltage of 24 to 32 volts at 100 amperes with regulation accuracy of $\pm 1/2$ per cent and a response time of 0.2 seconds maximum. Applications include centralized laboratory and plant d-c power, ground radar.

Machine Tools

Jones & Lamson Machine Co., Springfield, Vt., has issued a bulletin illustrating and describing machine tools for plant modernization.

Photos and specifications are included on turret lathes, automatic lathes, copying lathes, grinders and comparators. The booklet includes a discussion capital equipment replacement analysis.

Axial Fans

A 36-page two-color illustrated catalog describing Series 203 axial fans for ventilation, process air supply and process air recirculation applications is available from American Blower Corporation, Detroit 32, Mich.

The catalog describes and illustrates tube-axial and vaneaxial flow principals and explains the various arrangements possible with the company's axial fans. Design and construction features as well as specific recommended applications are thoroughly discussed. Photographs illustrate the features described and show production facilities.

PREFERRED Limits and Fits for Cylindrical Parts

Developed for use wherever it might serve to improve and simplify products, practices, and facilities, this American Standard:

lists and defines the terms applying to fits between plain (non-threaded) cylindrical parts,

presents in tabular form the preferred basic sizes of mating parts, the preferred tolerances and allowances, and a series of standard tolerances so arranged that for any one grade they represent approximately similar production difficulties throughout the range of sizes,

recommends five types: Running and Sliding Fits, Locational Clearance Fits, Transition Fits, Locational Interference Fits, and Force or Shrink Fits,

gives the standard types and classes of fits on a unilateral hole basis so that the fit produced by mating parts in any one class will produce approximately similar performance throughout the range of sizes,

prescribes the fit for any given size or type of fit; also the standard limits for the mating parts which will produce the fit,

contains an appendix giving the limits of size for holes and shafts for additional classes and grades of fits which special conditions may require.

Diameters up to 200 in. are covered with sizes in accordance with the British, Canadian, and American agreements (to 20 in.) shown in bold face type.

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Refrigeration Manual

A third edition of the firm's refrigeration manual has been published by Trane Co., La Crosse, Wis.

Now in its fourteenth printing since first published in 1946, the manual includes new information on condenser fouling factors, motors and motor control equipment, mufflers, single and multiple compressor piping arrangements, calculating Freon-22 piping sizes, pipe hanging and insulation of piping, and Freon-22 charging. New tables have been added to the chapter devoted to thermostatic expansion valves.

Glass Pipe, Fittings

A new catalog published by Fischer & Porter Co., 683 Jacksonville Rd., Hatboro, Pa., describes the company's line of glass pipe and fittings. Fabricated from Pyrex brand glass tubing, they are primarily designed for laboratory, pilot plant use or other special services. Sizes from 1/4 to 1 in. internal diameter, are kept in stock for immediate shipment.

In addition, the catalog describes new threaded metal couplings for metal-to-glass and glass-to-glass connections plus high pressure glass stopcocks which are offered in spigot type, two-way and three-way designs.

Cylinders, Valves

Pathon Mfg. Co., Pacific Ave., Cincinnati 12, Ohio, announces a new comprehensive catalog, Bulletin No. 22 A., on oil hydraulic cylinders and valves. It contains information on Series QH 1000 psi and RH 2000 psi and the Hydraulic directional control valves.

Metalworking Machines

Famco Machine Co., 3100 Sheridan Rd., Kenosha, Wis., has issued a new general catalog, incorporating all the newest designs and features of its metalworking machines.

This catalog includes data, specifications, photos, and descriptions on power presses, arbor presses, air presses, drill presses, foot presses, band saws, and squaring shears.

Adhesives Specs

A new 14-page, folder listing official United States government specifications for a variety of adhesives, coatings and sealers is available from Adhesives and Coatings Div., Minnesota Mining & Manufacturing Co., 423 Piquette Ave., Detroit 2, Mich.

The folder lists, in file type form, various Military, Army, Navy and Federal specification designations with the firm's corresponding adhesive, sealer or coating that meets government specification requirements. Each page has a tab designating the type of Government specification to be found on that page. Also included is a specification cross reference section listing recent changes in specification designations to aid in correlating old and new specification numbers.

But did you know...

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• SURGE RELIEF • PRESSURE REDUCING
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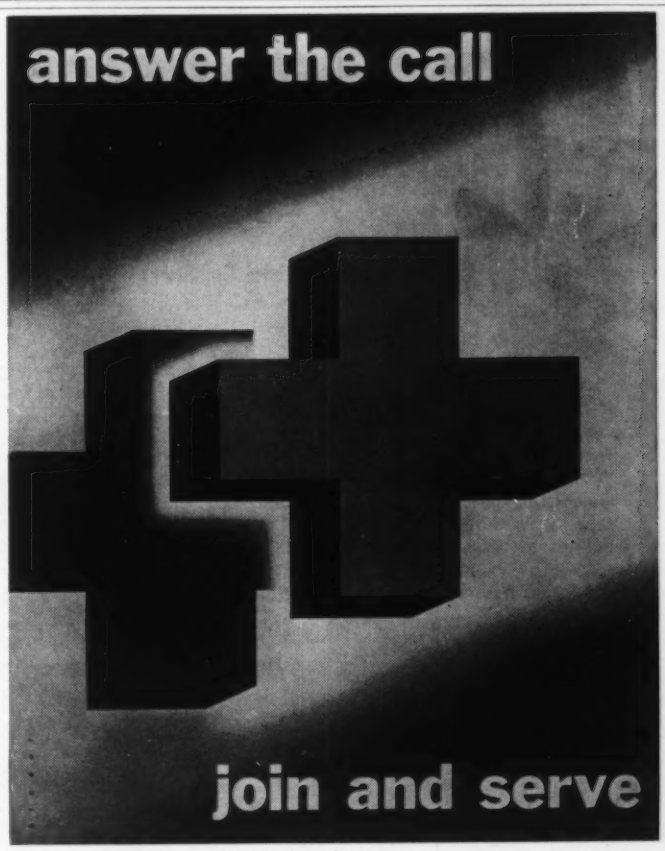

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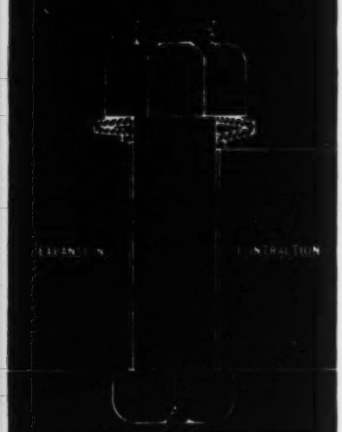

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Transmission Film

A new 16-mm. sound and color film, "Semi-Automatic Roadranger Transmissions," has been released by Fuller Mfg. Co., Transmission Div., Kalamazoo, Mich.

The movie is a driver instruction film, showing the ease of operating the transmissions under all driving conditions. How drivers and operators use the semi-automatic transmissions, and what they have to say about them, are shown in scenes taken "on location" of a number of leading truck transportation companies throughout the United States. The 25-minute film is being distributed free through truck dealers and distributors.

Laboratory Homogenizer

A laboratory homogenizer, specially designed for research, pilot plant or limited production operations is covered in a new four-page folder released by Manton-Gaulin Mfg. Co., 44 Garden St., Everett, Mass.

The literature describes the operation of the laboratory-sized unit, covers representative types of products which can be processed and gives details on a special homogenizing valve. This unit handles more than 65 different types of food and chemical materials, from fluid to highly abrasive.

Refrigeration Condenser

Bulletin No. 130, "Sectional Aeropass Condenser," four pages, showing benefits of new, sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity is available from Niagara Blower Company, 405 Lexington Ave., New York 17, N. Y.

Plastics Definitions

Data on all types of plastics, definitions and detailed information on working with and buying plastics, are available in a manual and catalog offered by Fry Plastics Co., 7826 S. Vermont Ave., Los Angeles 44, Calif.

The 100-page catalog lists hundreds of different items, their uses and applications, with unit and quantity prices. Included are such materials as acetate, Lucite, Plexiglas, vinyls, Saran, nylon, polyethylene, phenolics, polystyrene, polyesters, reinforced plastics and coatings.

Double Action Presses

Double action straight side presses ranging from 200- to 2000-ton capacity are shown in a catalog published by Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chicago 50, Ill. One-, two- and four-point suspension presses are included in the illustrated, 28-page book.

Special features of the presses, such as adjustable, extra heavy slide connections, extra long gibbing, automatic oil lubrication, and the exclusive Danly "Micro-inching" Drive are shown in detail.

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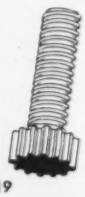

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Roller Bearings

Greater load capacity and simplified application are features of self-aligning roller bearings described in an eight-page book, No. 2658, released by Link-Belt Company, Prudential Plaza, Chicago 1, Ill. The book describes Series S, adjustable single-row self-aligning roller bearings, Series D, adjustable double-row bearings, and Series M, pre-adjusted double-row self-aligning bearings.

It also gives engineering selection information, dimensional specifications and recommended fitting practices.

Servo Motors

Norden-Ketay Corp., 555 Broadway, New York 12, N. Y., has issued bulletin 376, giving the characteristics of more than 138 synchros, servo motors and resolvers. The company says the bulletin is designed as a guide to the selection of rotating components.

Cored Forgings

"Cored Forgings" is the title of a six-page brochure by Weatherhead Co., Aviation Div., Antwerp, Ohio, announcing the company's readiness to supply specification cored forgings in aluminum and other non-ferrous metals.

The brochure sets forth the advantages offered by this new forging technique, including finer grain structure, far less flash with corresponding less material input, close tolerances, and high strength. Forgings may be cored four ways in the same plane.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Centrifugal Compressors

Clark Bros. Co., Inc., Olean, N. Y., has available a 32-page bulletin covering its line of centrifugal multi-stage compressors for high capacities.

Cutaway photos, application photos, dimension diagrams and a section covering the engineering data and performance characteristics of the units are included in the booklet.

Transfer Switches

A 16-page brochure in color, "Factors to Consider in the Selection of Automatic Transfer Switches," is available from Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

Ten features required for adequate design are listed, and information is given on why these features are essential. Additional information includes selection of type, how to specify the switch capacity, calculating line currents and a suggested specification for automatic transfer switches.

Rotary Chemical Pumps

Descriptive and engineering data covering a rotary displacement pump line for corrosive and hazardous fluids is contained in a folder obtainable from Eco Engineering Co., 12 New York Ave., Newark, N. J.

Designed for chemical handling, the pump is listed as available in several corrosion resistant alloy combinations with inert nonmetallic impellers, seals and packing. A general description of its design and applicability is followed by construction and performance data, complete operating specifications on stock models, dimensional data, and specific information on component materials, drives and mounts.

DEFINITIONS OF OCCUPATIONAL SPECIALTIES IN ENGINEERING

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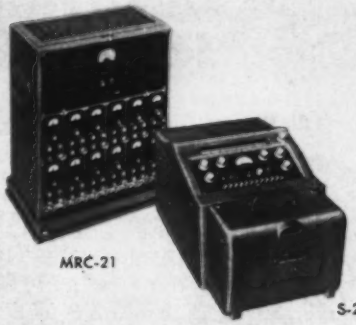

Dynamic Analysis

The new Hathaway S-25 oscillograph and the MRC-21 strain gage and transducer control unit constitute an unusually convenient, accurate and versatile system that has all the features engineers need for complete dynamic analysis . . . carrier or wide-band amplification . . . 0 to 6000 cps response.

Write for Bulletin 51-G

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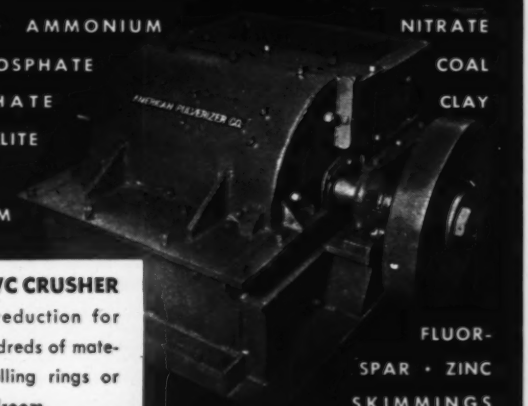

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Inert Gas Welding

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y., has issued a bulletin on its manual or mechanized Heliarc welding.

In using this process of inert gas shield arc welding, no flux is required, the company says. An inert gas, such as argon, shields the weld and weld area from the effects of the air.

Air Devices

An illustrated, four-page circular, describing its line of air devices, has been prepared by Lunkenheimer Co., Cincinnati 14, Ohio. Dimensions, pressure requirements and complete descriptive information on each device in the complete line are included in the circular.

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High Capacity Filter

A newly engineered, high capacity, simplified filter for diesel fuel and lube, pipelines, process liquids, water, gasoline and aviation fuels is described in Catalog MK-170, available from Cuno Engineering Corp., Meriden, Conn.

The filter is designed for flow rates up to 2000 gpm in a small space and to offer four degrees of filtration down to 1 micron. Fast, easy cartridge changes are said to be main features of this design. Specifications, flow rates and engineering drawings are included in the four-page catalog.

Tubing Alloys

Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa., has issued a six-page folder, TDC-163A, on analysis, mechanical and physical properties and creep and rupture data on tubing alloys for elevated temperature service.

Mercury Vapor Lights

A new booklet, "Better Industrial Lighting with Mercury Vapor," has been announced by Sylvania Electric Products Inc., Salem, Mass. The manual contains a summary of eight basic advantages of using mercury vapor lamps in industrial plants.

Photographs show typical applications, and a section on engineering hints for effective installations is included. It discusses the proper use of high bay reflectors and tells various ways to meet color requirements. The manual also contains information on how to combine mercury vapor lamps with fluorescent or incandescent lighting.

Pilot Check Valves

Two new catalog sheets, illustrating and describing its $1/4$, $3/8$ and $1/2$ in. double pilot check valves, have been published by Fluid Controls, Inc., 1284 N. Center St., Mentor, Ohio.

The valves are used to lock a cylinder without leakage. The "double" feature locks the cylinder in both directions as compared to regular pilot checks which lock a cylinder in one direction only. According to the company, they are generally used with a control valve which leaks, the combination producing a leakproof control. The valves are designed so that the internal parts are not subject to impact and resultant failures associated with locking valves.

Mine Service Pipe

"Transite Mine Service Pipe with Ring-Tite Coupling" is the title of a 12-page, illustrated brochure issued by Johns-Manville, 22 E. 40th St., New York 16, N. Y.

The brochure suggests a range of uses for this asbestos cement pipe, describes how it is made, and gives case histories of various installations. Special emphasis is placed on the recently introduced coupling.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Heat Exchanger

An extended surface design of heat exchanger with longitudinally finned tubes is described in a bulletin published by Griscom-Russell Co., a subsidiary of General Precision Equipment Corp., Massillon, Ohio.

This unit, known as the Twin G-Fin Section, was developed by the company more than 20 years ago for handling fluids of unequal heat transfer rates. More than 70,000 units have been installed on heating, cooling, condensing and heat exchange services.

Heating Devices

Bulletin GEC-1005G, 60 pages, containing application index, calculating data, specifications, operating information, and list prices of standard heaters and heating devices, is available from General Electric Co., Schenectady 5, N. Y.

Included are immersion, strip, cartridge, tubular, fin, and railroad switch heaters; unit heaters, soldering irons, glue pots, soft-metal melting pots, oven equipment, and control. Process and application index shows methods of heating and type of heater recommended for various heating processes.

Fasteners Catalog

Clark Bros. Bolt Co., Milldale, Conn., has issued a 44-page condensed catalog covering the company's line of bolts, nuts, rivets, screws and other industrial fasteners. The catalog contains illustrations, sizes, packaging information and prices on the most popular items in the company's line.

Wire Rope Assemblies

A bulletin describing the range of fittings and wire rope assemblies, has been prepared by Wire Rope Div., American Chain & Cable Co., Inc., Wilkes-Barre, Pa. This 24-page bulletin, TL 500, contains data on construction features, applications, breaking strengths and other general information of interest to design engineers.

The catalog shows the combinations of standard fittings and assemblies for such uses as anchor cables, bridge railings, conveyor cables, coal loading assemblies, coupler cables, foot pedal controls, hoist cables, lug assemblies, pull up cables, safety belt assemblies, tow cables, transmission hoists, yacht rigging.

Coal Cleaning

McNally Pittsburg Mfg. Corp., Pittsburg, Kan. has issued a bulletin giving detailed technical data on its various coal cleaning processes.

The 40-page bulletin contains photographs, diagrams and illustrations on the firm's dense media process, jig washer, standard washer, universal washer, single compartment unit, the unit washery, the Rheolaveur, vacuum jig and cone washer.

Class III Fan Catalog

Trane Co., Lacrosse, Wis., has published a catalog covering Class III fans, designed for high velocity air conditioning systems. The firm says the fans are also ideally suited for industrial use.

Air capacity ratings for the fans range in static pressure from 5 through 11½ in., in ½-in. increments, with a total high pressure limit at 12¼ in. The fans are cataloged in single and double width arrangements, in sizes 18 through 73.

D-C Motors, Generators

Bulletin GEA-6355, 12 pages, describing new Kinamatic d-c motors built to new NEMA standards, is available from General Electric Co., Schenectady 5, N. Y.

Information is given on electrical and mechanical features, versatility of standard line, features for easier maintenance, plus dimensions and ratings. Also available is a new bulletin, GEA-5461, six pages, illustrated, describing Kinamatic generators, ¾ to 100 KW.

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FIRST

Using a new type friction material of recent development, ROCKFORD was the FIRST to engineer these new materials into MORLIFE Clutches and Clutch Plates. They reduce clutch size and engaging pressure, operate longer without adjustment or plate replacement — and avoid down-time caused by burned or warped plates in heavy duty tractors, trucks, tanks, cranes, power units, shovels, bulldozers, earth movers and other heavy duty machines.

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"MORLIFE clutch has gone 851 hours without slipping or adjustment."

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400% MORE LIFE

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Before you approve specifications for your next models, it will pay you to investigate how MORLIFE Clutches will add to the service life of your product and reduce the number of stops for adjustments and repairs. It also will pay you to recheck specifications for your present models. For information covering operating characteristics, write Department E.

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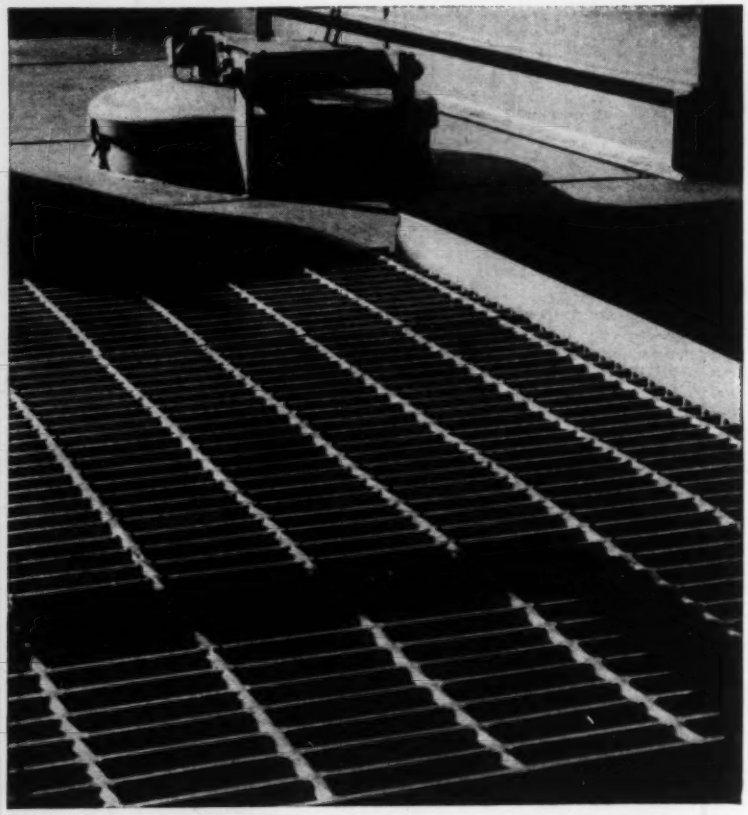

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Indoors or outdoors, you can provide safe walking conditions throughout your plant on floors, stair treads, platforms, walkways and catwalks. For Blaw-Knox Electroforged Steel Grating brings you these exclusive features:

1. rigid one-piece construction—easy to install
2. non-slip twisted crossbar—for safe footing
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   - square bars—for smoothest walking surface
   - knurled bars (Furro-Grip)—for extra safety plus relatively smooth walking surface
   - serrated bars—for maximum safety under extremely hazardous skid conditions
4. no sharp corners to clog—self-cleaning
5. all surfaces accessible—easy to paint
6. maximum open area—for light and ventilation

Write for your copy of new Bulletin No. 2486 —or send dimensional sketch for quotation.

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BLAW-KNOX COMPANY

BLAW-KNOX EQUIPMENT DIVISION

Pittsburgh 38, Pennsylvania

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating

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Insulation Graph

Graphical heat-loss data for establishing thickness and temperature requirements for the combination of mineral wool insulating block and white mineral wool insulating-finishing cement has been published by Baldwin-Hill Co., 500 Breunig Ave., Trenton, N. J.

Use of the graph eliminates calculations for determining outside surface temperature and surface heat loss for various standard thicknesses of mineral wool block insulation and a standard $^3/_8$-in. thickness of white mineral wool insulating-finishing cement. Thicknesses of block up to 4-in.; hot surface temperatures to 1700 F; and outside surface temperatures to 220 F are covered.

Automation Package

A specification sheet on a new Renco-aire automation package, with micro-action air operated directional valve is available from Renco-Toledo, Inc., 819 N. Reynolds Rd., Toledo 7, Ohio. It is designed to convert hand powered machine tools to fully or semi-automatic operation. Included are photographs, scale drawings, construction data, specifications, and prices for the complete air-cylinder automation package and component parts.

Small Press Brake

Dreis & Krump Mfg. Co., 7400 S. Loomis Blvd., Chicago 36, Ill. has issued a four-page bulletin, No. 131-56, illustrating and describing the design and construction features, with complete specifications, of its Model 131, 11-ton capacity press brake.

Boltless Shelving

Boltless steel shelving is the subject of a new 12-page illustrated color catalog, No. 706, released by Frick-Gallagher Mfg. Co., 110 S. Michigan Ave., Wellston, Ohio.

The catalog contains a comprehensive discussion of the Klip-Bilt principle, showing how the shelving may be erected, and a detailed survey of the various models of open, closed, and ledge type shelving available.. The component parts and accessories necessary for shelving construction are shown in detail, along with several other types of special and high strength shelving.

Vibration Mountings

A line of floating rail vibration mountings and fan and motor bases is described in a catalog issued by T. R. Finn & Company, Inc., Industrial Div., 200 Central Ave., Hawthorne, N. J. The units are designed for use with refrigeration and air conditioning equipment.

Detailed descriptions of design features are given and include high deflection rubber-in-shear isolators and channel supports. All units have a natural frequency of 370 cycles per minute and are recommended by the company for a disturbing frequency of 750 cycles per minute.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Aluminum Forgings

Bridgeport Aluminum Div., Bridgeport Brass Co., Bridgeport 2, Conn., has issued a 16-page bulletin illustrating and describing aluminum forgings.

The company's facilities for producing forgings are illustrated, along with forging data, design factors and tolerances. One section of the booklet tells the story behind the world's largest aluminum die forging.

Precision Bearings

Information on anti-friction bearings for special applications is available in catalog AFB-1, prepared by Industrial Tectonics, Inc., 3684 Jackson Rd., Ann Arbor, Mich.

Dimensions and load ratings are given for single row, double row, deep groove radial, and angular contact bearings. In addition, general bearing requirements for special designs, high and low temperatures, corrosion resistant and non-magnetic properties, and electrical conductivity and insulating features are discussed in the 32-page illustrated catalog.

Canned Motor Pumps

A four-page, two-color bulletin, 1040, illustrating construction and operation of high temperature Series T canned motor pumps is available from Chempump Corp., Station L, 1300 E. Mermaid Lane, Philadelphia 18, Pa. The units are designed for leak-proof pumping of such fluids as Dowtherm, Arochlor, Para-Cymene and others at temperatures to 1000 F. Details on performance, materials of construction, dimensions, power requirements and other specifications are given.

Bronze Globe Values

A detailed, three-color circular on a bronze globe valve is being offered by the Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

Addition of the new 200 lb line makes the firm's LQ600 valve available in two complete series. Both lines are made in eight different sizes, from $1/4$ through 2-in. diameters. The company says in five years of actual service in the field, the patented Brinalloy seats and discs used in the unit have required no replacement, repair, or maintenance.

Filter Bulletin

A bulletin describing an automatic dry-type air filter has been released by American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.

Designed particularly for textile mills, newspaper pressrooms, and specialized applications such as food processing plants, atomic energy installations, hospitals and sugar refineries, the unit is said to provide for efficient, economical collection and disposal of lint, ink mist, fibrous materials and other materials that have posed a problem for air filter engineers.

Peerless Development Engineer Richard Thompson (at control board) guides unit through development and George Goldner conducts final inspection.

VERIFIED BLOWER PERFORMANCE

● It just makes good sense to specify Peerless. Every fan or blower leaving our plant is unconditionally guaranteed to meet all established industry test codes (NAFM or PFMA). To an engineer, guaranteed performance means specifying without doubt —to a contractor it means good performance and no callbacks.

OUTSTANDING PERFORMANCE. The outstanding service records of Peerless fans and blowers stem from excellent design and thorough tests in every step of development and manufacture. A minimum of eight, 20-point determinations are made during the development period alone.

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COMPLETE LINE. There is a Peerless fan or blower for virtually every application. Complete data is catalogued for easy reference. Peerless Bulletin SDA-160 shows fans and forward curve blowers. Bulletin SDA-200 gives complete data on backward curve blowers (NAFM) from 12½" to 36½". These two bulletins will help you solve most air-moving problems. Dimension prints are available on request.

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THE Peerless Electric® COMPANY

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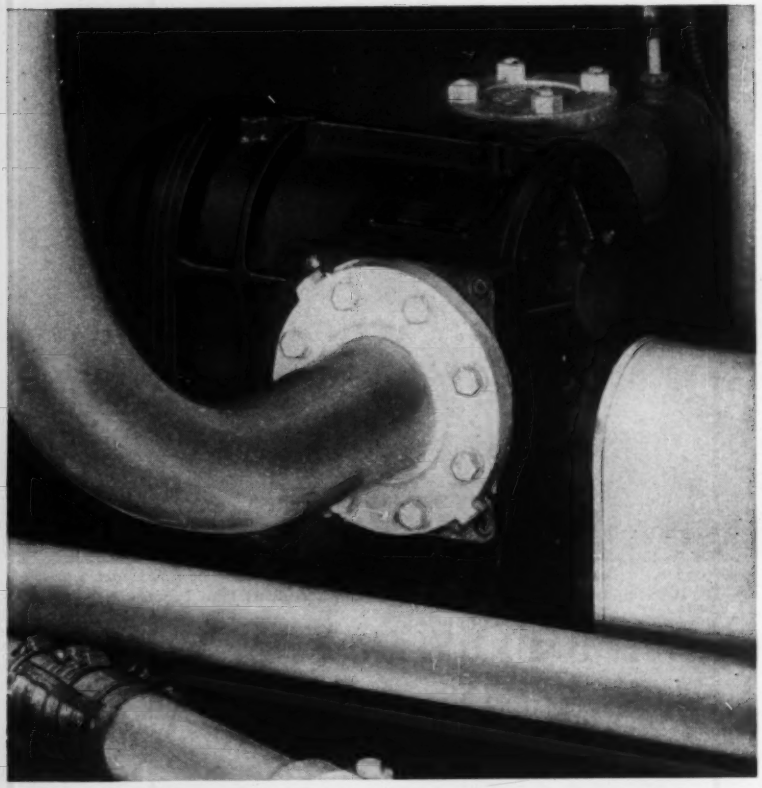

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have been serving many of America's largest bakeries since 1950

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There are two basic reasons for this remarkable, money-saving performance. (1) The Standardaire's simple, extra-rugged construction. (2) Its efficient, exclusive cycloidal design.

Standardaire rotors actually never touch. Thus, wear, due to friction, is entirely eliminated and there's no need for internal lubrication.

In addition, you'll find that compact Standardaire Blowers deliver more air with less power consumption than any other units of equal size or weight.

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Tooling Inserts

A 12-page folder which illustrates Kendex tooling with button-type throw-away inserts is available by Kennametal Inc., Latrobe, Pa.

The two-color booklet, B-301, describes features that include solid chip breakers and shims or insert seats. More than 200 tools are listed in 17 holder styles, 11 of which are negative rake. Square, round, triangular turnover type and heavy-duty inserts eliminate regrinding and are precision-indexed with minimum delay, according to the firm.

Electroplating

A revised, expanded edition of "Data and Directions for Electroplating with Rhodium," has been published by Baker & Co., Inc., 113 Astor St., Newark, N. J.

The booklet lists and describes various applications of Rhodium plating as a decorative finish, in electrical and electronic devices, in special reflectors and mirrors, orthodontic supplies, chemical process equipment and medical instruments.

Automation Products

Automatic Temperature Control Co., 5200 Pulaski Ave., Philadelphia 44, Pa., has issued Catalog D-31 covering products and services offered for the field of Automation.

Some of the products covered are differential transducer control and automation systems, a complete line of time control equipment including electronic, equipment operator mechanisms, valves, counters and electronic contactors.

"Apcotite" Brochure

An eight-page brochure is available to design and material engineers who are interested in the bonding of rubber, natural and synthetic, and silicone to metal from Acushnet Process Co., 752A Belleville Ave., New Bedford, Mass.

The brochure features a new rating chart showing the latest materials that can be successfully bonded to various polymers. Photographs show industrial applications.

Linear Roll Pressure

An industrial engineering report, No. 9, entitled "Effect of Linear Pressure on Rubber Covered Squeeze Rolls," has been published by Industrial Roll Div., Rodney Hunt Machine Co., Orange, Mass.

Discussing the degree to which high pressures commonly used in modern equipment decrease roll life, the report provides data on the relationship between softness of the rubber covering, nip width and unit pressure at the center of the nip. Included is a graph which correlates various linear inch pressures with nip width and unit pressure at the nip for hard and soft rubber covered rolls. Another graph illustrates how the configuration of material passing through the nip affects roll life.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Vertical Pump Motors

Embodying 66 full-colored illustrations and technical drawings depicting features and applications of various types of vertical turbine pump motors, a new brochure is ready for distribution by U. S. Electrical Motors Inc., Box 2058, Los Angeles 54, Calif.

It describes hollow shaft Verticlosed grease- and oil-lubricated motors in sizes from $1^1/_2$ to 400 hp; single phase designs up to $7^1/_2$ hp; totally-enclosed types up to 150 hp. Various arrangements of bearing settings are presented, along with an improved design of backstop to prevent backspin of the pump shaft when the pump is shut off and water recedes.

Relay Maintenance

A general discussion of protective relay maintenance and testing with particular attention to the equipment and records that are necessary for assuring safely operative relays and breakers has been published by Multi-Amp Corp., 10 Third St., Newark, N. J.

The folder describes the general types of test equipment commercially available, auxiliary instruments required for trip-time calibration, the standard means for conducting these tests and the normal routine to follow. A comparison table lists characteristic advantages of various techniques in current application with respect to safety, ease of handling, accuracy and versatility.

Reduction Gears

A new booklet that describes high-speed reduction gears for mechanical-drive steam turbines is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Having capacities ranging from 50 to 5000 hp, the reduction gears are designed to bring the efficiency of the high-speed steam turbine to slower-speed driven equipment such as pumps, fans, compressors, line shafts, and generators.

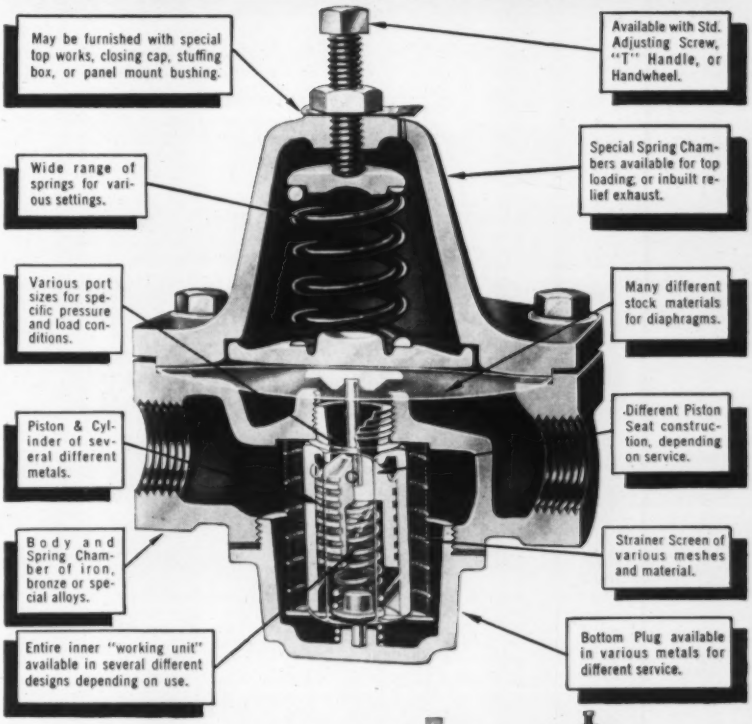
The booklet describes in detail the various parts of the gear assembly and lists complete dimensional and weight specifications. Included also are drawings of the assembly.

1-Shot Lubricators

Semi-automatic lubricators that can service as many as 100 or more bearings on a machine are described in Bulletin 3C, a two-color, four-page brochure offered by Bijur Lubricating Corp., 157 W. Passaic St., Rochelle Park, N. J.

Called One-Shot lubricators, the units are hand operated by means of pull, push or lift type levers. They are used on machines requiring closely controlled but infrequent oiling, including some types of textile machinery, punch presses, heavy machine tools and many special machines. Three different basic models are described in the bulletin, with detailed diagrams showing dimensions, reservoir capacities and discharge volumes of each model.

how *Cash-Acme* provides the *Correct Answer* to 1,017 reducing valve cost problems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Available with Std. Adjusting Screw, "T" Handle, or Handwheel.
Wide range of springs for various settings.
Special Spring Chambers available for top loading, or inbuilt relief exhaust.
Various port sizes for specific pressure and load conditions.
Many different stock materials for diaphragms.
Piston & Cylinder of several different metals.
Different Piston Seat construction, depending on service.
Body and Spring Chamber of iron, bronze or special alloys.
Strainer Screen of various meshes and material.
Entire inner "working unit" available in several different designs depending on use.
Bottom Plug available in various metals for different service.

Here's How: With over 1,017 models and modifications of Cash-Acme's *standard* Type B Pressure Reducing Valve available and already in high production, the *right* regulator can usually be quickly selected from stock to do the job you require. This offers important cost savings as delays, special tooling and custom design and engineering are eliminated.

Do as other cost conscious engineers and purchasing men are doing and switch to CASH-ACME.

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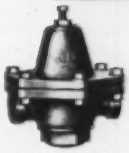

Type "B"—Rugged Industrial Type Pressure Reducing Valve ...A truly *universal* piece of equipment. Standard models for:

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A. W. CASH VALVE MANUFACTURING CORP.
6627 East Wabash Avenue
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Heating Elements

Electro-Flex Heat, Inc., Hartford, Conn. announces publication of an eight-page booklet listing its line of standard Hi-flex and Electro-thin elements and illustrates typical custom units. The cover photo indicates shape and flexibility variations possible with these silicone rubber or neoprene strip and blanket type electric heating elements.

Hydraulic Press

Pasadena Hydraulics, Inc., 273-279 N. Hill Ave., Pasadena 4, Calif., has issued a bulletin showing specifications on its open side 20-ton O-225 type press.

The unit has a $4^1/_2$-in. stroke, 4-in. ram and a $4^1/_2$-in. opening with quick removable adapter to obtain an additional 4 in.

WORN Cylinders?

SCORED Cylinders?

PORUS - KROME

Good for the Life of your Engines

is the answer.

- Reclaim the bores of worn or scored power cylinder liners with wear resistant PORUS-KROME.
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*SparTan Engineering

Centennial Catalog

Eagle Pencil Co., 703 E. 13th St., New York 9, N. Y., has issued a 32-page Centennial catalog in four colors, telling history of the firm's 100 years. Included is data on laboratory testing methods, plus the how, what and why of general writing pencils, colored pencils, drawing pencils, leads, erasers, and pencils created for special tasks.

Weather-Protected Motors

Construction features of weather-protected motors for outdoor installation are described in a new bulletin released by Allis-Chalmers Mfg. Company, 949 S. 70th St., Milwaukee, Wis.

The motors are available in all commonly used ratings, both horizontal and vertical, 250 hp and above. Construction features described in this bulletin also apply to the larger machines in this category. Mechanical features are portrayed by means of a cross section diagram of a typical 700-hp, 2300-volt, 1185-rpm squirrel-cage induction machine.

Welding Procedures

A 140-page pocket data book, TIS 2575, said to feature simplified welding procedures for every base metal is available from Technical Information Service, Eutectic Welding Alloys Corp., 40-40 172nd St., Flushing 58, N. Y. The book covers 120 welding rods, electrodes and welding compounds, and is a guide to improve torch and metallic arc welding, brazing and soldering.

How-to-weld information is given for fabrication, maintenance repair and salvage, overlaying for wear and corrosion resistance and welding of dirty, rusted parts. Special welding applications such as joints with high electrical conductivity, resistance to chemicals, tinning and plating are covered. Data is also given on methods of gouging, chamfering and removing of unwanted metal without special equipment.

Extrusion Film

A 16-mm color sound film on pressure on extrusion production is available from Lake Erie Engineering Corp., Box 68, Kenmore Station, Buffalo 17, N. Y.

Aluminum, brass, and steel extrusion processes are described with particular emphasis and explanation given to the interaction of press components during the extrusion cycle for aluminum. Loading, sealing, extruding, stripping, and shearing are visualized for the various types of presses. Scenes demonstrate the technique developed by Ugine-Sejournet for the extrusion of hot steel using glass as a lubricant.

Specific treatment is given to the firm's rotary die slide mechanism along with the special loading arrangement and a comparison between long and short stroke presses. Fabrication and assembly scenes are included.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Rubber Pipe

A wire-reinforced rubber pipe for eliminating noise and vibration from water lines is described in a catalog issued by T. R. Finn & Company, Inc., 200 Central Ave., Hawthorne. N. J. Sizes available range from 1/2 to 12 in.

Construction details of the pipe include a smooth inner lining of high-tension abrasion-resisting rubber, pipe walls of rubber impregnated wire-reinforced fabric imbedded in rubber for their full length, and outer wall coverings of abrasion, sun and weather-resisting rubber. Small pipes are equipped with male iron pipe thread fittings. Large sizes have integral full-faced rubber flanges backed with either 150- or 300-lb drilling steel flanges also imbedded in rubber.

Steel Boilers

Catalog AP-237-F, 44 pages describing steel boilers for heating homes, commercial and industrial buildings is available from the Pacific Steel Boiler Div., National U. S. Radiator Corp., Johnstown, Pa.

The literature presents ratings and capacities, plus dimensions and engineering data, for the line of boilers. Brief descriptions of boiler types, firing method and capacities are included. The new literature states that easy erection of the boilers in new buildings is achieved by a two-piece construction. For replacement jobs, says the catalog, the use of split firebox boilers makes possible their being brought into structures through doorways, windows or skylights.

Mounted Wheels

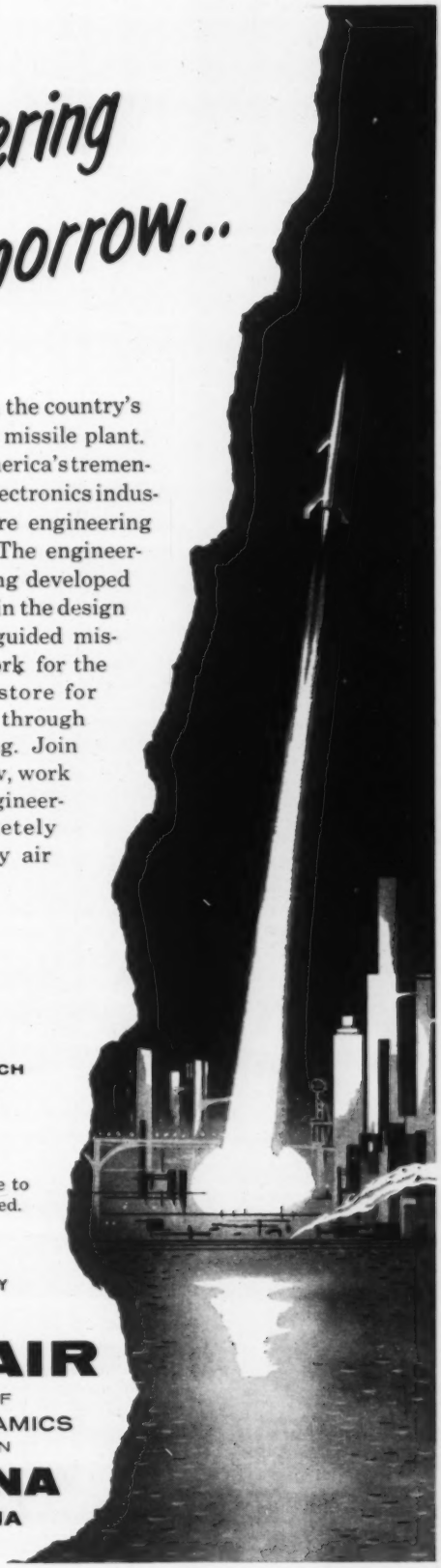
A 36-page booklet entitled "Mounted Wheels" has been issued by the Grinding Wheel Institute, 2130 Keith Bldg., Cleveland 15, Ohio. This publication represents the first time that information on maximum operating speeds for this abrasive product has been available, the organization says.

Eight maximum speed tables are included in the booklet to facilitate users correct application. The booklet also contains rules for safe and efficient operation and information on standard sizes of mounted wheels together with standard mandrel sizes applicable for each. There are three pages of silhouette drawings of the popular standard sizes of mounted wheels.

Plastics Catalog

A revised catalog, detailing its line of polyethylene and polyvinyl chloride sheet, bars, rod and blocks, moldings and weldments, plus its welding and spraying equipment, has been issued by the American Agile Corp., Box 168, Bedford, Ohio.

The literature contains much of the information of its predecessor, except that it devotes considerable space to the firm's recently introduced powder fluidizer. This unit has been designed for coating small objects with polyethylene and other fusible powdered materials. Powders used with this new process are described.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Testing Instruments

Eighty different devices are covered in a 40-page "testing-instruments reference book" published by General Electric's Instrument Dept., Schenectady 5, N. Y.

Titled the "Measurement Equipment Catalog," GEC-1016, the publication contains applications, sources of additional information and pictures. Ranging from simple thickness gages to the mass spectrometer leak detector, there are instruments for research, production, laboratories and educational use. Measurement categories include color, leak detection, insulation, and radiation monitoring.

Thermal Insulations

A 20-page catalog on thermal insulations and refractories for general industrial applications has been published by Johns-Manville, 22 E. 40th St., New York 16, N. Y.

It provides information on the composition, physical and thermal properties and sizes of the various products, and lists benefits which the products provide both at the time of installation and in service. It covers materials for the efficient control of temperatures from −400 to +3000 F.

Dispersion of Pigments

A new sub-micron disperser is covered in a new 4-page folder published by the Manton-Gaulin Mfg. Co., 44 Garden St., Everett, Mass. Designated the S-M-D, this machine is presented as having nine special features where its exceptional high velocity sheer will improve product quality and reduce production costs.

Construction and operation of the Sub-Micron Disperser are covered along with specifications and a detailed description of how the unit is applied to all types of pigment dispersions.

Industrial Wire Rope

Wire Rope Recommendations for Industrial Services, bulletin No. DH-128D, 24 pages, has been issued by American Cable Div., American Chain & Cable Company, Inc., Wilkes-Barre, Pa.

Covered are more than 120 different types of wire ropes used in construction, in conveyors, in cranes, in dredges, in railroads, in steel mill and blast furnaces, and for coal bridges, grain shovels, guy ropes, inclines, pile drivers, platform lift trucks and winch lines.

Water Treatment

W. H. & L. D. Betz, Gillingham and Worth Sts., Philadelphia 24, Pa., announces the publication of Technical Paper No. 133, "Determination of Carbon Dioxide in Water by Conductivity Measurements."

The paper describes a new method developed for the determination of carbon dioxide which is applicable to analysis of waterside deposits, treatment chemicals and organic carbon in water. The principle of differential conductivity permits rapid, accurate analyses.

Cap Screw Folder

Making a metal blank larger and smaller at the same time by the cold-forming Kaufman double-extrusion process is described in a four-page folder by Cleveland Cap Screw Co., Cleveland, Ohio.

The process permits the upsetting of metal for the head of a cap screw at the same time as the shank diameter is extruded down to an accurate pitch diameter for the rolling of threads. Each step of the cold-forming process on a Boltmaker is described in pictures and text in the folder.

Infra-Red Oven Sections

Safety Car Heating and Lighting Co., Inc., Box 70, Milford, Conn., has available a four-page bulletin giving specifications and dimensions of lightweight infra-red oven sections.

Applications listed are for baking, heating and drying in a variety of industries.

Process Control

An eight-page catalog describing several electro-optical instruments for process control has been published by Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn.

Described in the catalog are infrared radiometers for use in remote temperature measurement, infrared detectors for detection of infrared radiation, an industrial process refractometer for controlling the purity of process streams, and infrared sources and detector preamplifiers used as building block components in infrared systems.

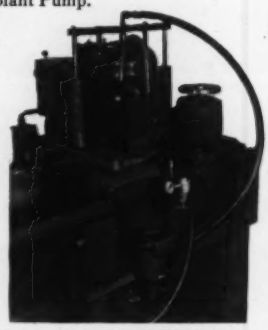
Indexing Units

Ferguson Machine & Tool Co., Box 5841, St. Louis 21, Mo., has issued a 24-page catalog, No. 106, containing full selection and application data on high speed indexing mechanisms now available from stock.

Included are methods of calculating load requirements, load ratings based on a minimum of 8000 hours operation without maintenance and dimensions of the many stock and standard drives. The catalog also introduces the new "Trans-Pac," a standard packaged power unit for indexing straight line assembly machinery.

for balanced performance specify RUTHMAN GUSHER COOLANT PUMPS

Illustrated is a Model 545 Lempco Automatic Wet Surface Grinder equipped with a "Gusher" Coolant Pump.



Here are the reasons why so many of the leading machine tool builders insist on "Gusher" Coolant Pumps for their machines.

MODEL 11022

BETTER PERFORMANCE — No priming is necessary — Gusher pumps deliver split-second flow from a trickle to full volume.

LESS MAINTENANCE—Heavy duty pre-lubricated ball-bearings and the absence of packing, foot or relief valves reduces the need of attention to a minimum.

LONGER LIFE — The rotating assembly of all "Gusher" Pumps is dynamically balanced . . . to reduce vibration and wear. There is no metal-to-metal contact within the pump housing. Gusher Pumps are precision built for a long trouble-free life.

THE RUTHMAN MACHINERY CO.

1823 Reading Road Cincinnati, Ohio

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Plastic Pipe

Plastic pipe, a $45 million market in 1955, and an estimated $85 million by 1960, is analyzed and evaluated in a comprehensive technical and market study entitled "Pipelines to the Future" published by Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.

Detailed charts and tables comparing the performance and cost of the important plastic and metal pipe materials, and listing the advantages and limitations of the major plastic types, are included in the book which is based on a technical report prepared as part of the company's plastics in construction program.

Defrosting Equipment

Bush Mfg. Co., West Hartford 10, Conn., has issued a 16-page bulletin covering low temperature defrosting equipment.

Included are illustrations, diagrams and specifications of hot gas defrost systems, electric defrost systems, glycol defrost product coolers, water defrost unit coolers and the firm's Therm-o-cycle system, a packaged hot gas defrost system.

Bellows Relief Valves

Crosby Steam Gage and Valve Co., 123 Georgia Ave., Providence 5, R. I., has issued a four-page catalog covering the design and construction of its Style JB bellows relief valve.

A listing of all parts and materials of construction is included, along with pressure ratings, capacity data, sizes and pressure-temperature limits. The catalog also discusses how the firm's bellows protector isolates and protects the bellows and serves as a positive lift-stop to prevent over compression of the bellows.

Engines, Generators

Enterprise Engine & Machine Co., 18th and Florida Sts., San Francisco, Calif., offers a complete ring binder catalog on its line of medium and slow-speed, heavy duty engines.

The literature covers diesel, dual fuel, trifuel and spark-ignited engines in five different basic models ranging from 73 to 7703 hp, and diesel generator sets ranging from 93 to 5502 kw.

Sub-Surface Washer

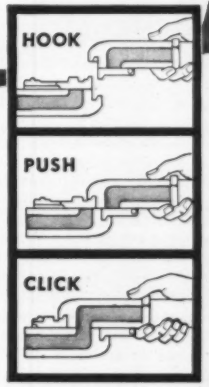
Technical reprint T-139 is available from Graver Water Conditioning Co., 216 W. 14th St., New York, N. Y. This paper discusses the development of the sub-surface washer, used in demineralizers, Zeolite softeners and filters.

The paper presents the causes of bed fouling of filters and the problems encountered with actual installations in a variety of industries. The steps leading to the development of the sub-surface washer are presented and a cut-away drawing showing this unit is included. Other descriptive material includes flow sheets and a diagrammatic sketch of pilot unit observations.

Magnetic Products

A catalog illustrating and describing the firm's line of magnetic products is available from Buck Mfg. Co., 121 Roberts Rd., Los Gatos 6, Calif.

The new literature contains detailed specifications and application listings for four models of portable magnetic drill presses, magnetic drill vise, and two models of the portable magnetic welders plate clamp.



Char-Lynn Hydra-Seal Hose Coupler

Low pressure drop in coupler allows full power for work.

Absence of internal parts assures least pressure drop of any coupler and eliminates cleaning problems. Designed and engineered as a quick-connect, self-sealing, break-away coupler for all fluid carrying lines.

Write for free catalog and further information.

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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Fan Clutch Data

Warner Electric Brake & Clutch Co., Beloit, Wis., has compiled a technical report analyzing the engineering features and operating advantages of custom-engineered fan clutches now available for internal combustion engines on trucks, automobiles, construction machinery, and stationary equipment.

The report lists the advantages gained through the application of a fan clutch to an engine, such as reduction in fuel consumption, increase in power, quieter operation, and faster warm-up, and covers the engineering reasons for these advantages. Fan clutch operation and methods of control are described in detail, with varying types of mountings listed.

CO_2 Analyzer Catalog

A four-page color catalog 56-553-1 published by Hays Corp., Michigan City, Indiana, contains photos of the different types of chemically operated CO_2 analyzers and recorders. Descriptions of the operation and sampling system are accompanied by drawings. Application, principle, features, available models and standard charts of these combustion meters are also covered.

Solenoid Valves

A comprehensive catalog from Atkomatic Valve Co., Inc., 545 W. Abbott St., Indianapolis, Ind., describes the company's line of electrically operated two-way solenoid valves for air, gas, steam and liquid flow control.

The catalog lists available dimensions, specifications, pressures and applications of solenoid valves in bronze and stainless steel. All the firm's valves are custom built and individually tested for a diversity of industrial uses. The illustrated catalog also contains numerous coil and flow charts and other useful information.

Control for Chucks

A brochure announced by Doall Co., Des Plaines, Ill., discusses "Selectrons" for effortless and automatic control of magnetic chucks. The brochure gives details concerning the method of obtaining d-c power from the rectifier and the principle involved in the infinitely variable control of holding power and the automatic demagnetization of chuck and work. A variety of installations are pictured and the various capacity ranges are given.

Wheel Catalog

A new catalog for original equipment manufacturers, illustrating and describing its line of semi-pneumatic wheels, is announced by Gleason Corp., 250 N. 12 St., Milwaukee 3, Wis.

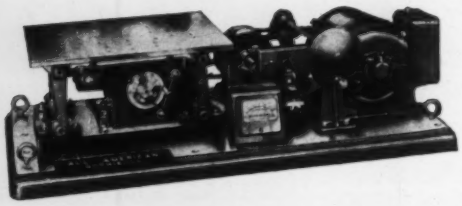
The catalog contains specifications and design engineering data for puncture proof, steel disk wheels used on portable equipment for the home, garden, farm, factory, and sporting field. Included in the catalog are suggestions for application of slow speed wheels, a series of questions about wheels with answers, and performance reports resulting from field and laboratory tests for wheel durability and stability.

Stainless Pipe

A technical folder published by Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa., furnishes pertinent information about various machining operations on stainless pipe and tubing.

Tooling, power requirements, cutting oils and finishing are briefly discussed along with drilling, threading, reaming, milling and sawing.

Range Selector Is Highlight Of All American Model 150 HLA-D Vibration Fatigue Test Machine



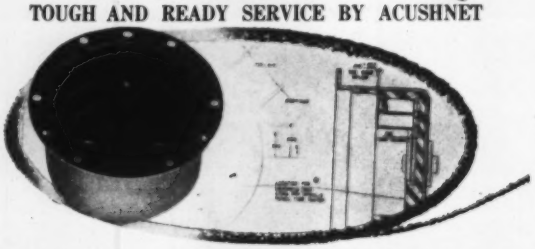
This machine, subjects parts or assemblies, up to 150 lbs. in weight, to a comprehensive vibration fatigue test. It has a 50% overload safety factor. Vibration in simple harmonic motion is produced horizontally. Displacement (double amplitude) is adjustable from 0" to 125". Automatic Range Selector controls acceleration and deceleration. From 10 cycles per second frequency may be increased uniformly to 60 c.p.s. and then decreased to 10 c.p.s. Any desired range within the total may be selected. Selector can be switched off and frequency held at any c.p.s.

Recommended for testing aircraft, electronic, electrical, mechanical or optical parts or components. One of 7 models. Send for Catalog F, containing helpful data, nomograph chart and listing typical users. Write to

ALL AMERICAN TOOL & MFG. CO.
8019 LAWNDALE DRIVE, SKOKIE, ILLINOIS
Makers of All American Precision Die Filing Machines

THE SHAPE OF THINGS IN MOLDED RUBBER

METER CASE MADE FOR TOUGH AND READY SERVICE BY ACUSHNET



The multiple problems in producing a Ruggedized Meter Case as shown here were:

A. Molding and bonding rubber to interior of metal case as shown. Holding dimensional tolerances as close as ± .003" - .002".
B. Cleaning metal case thoroughly without distorting.
C. Holding critical distances from the flange to mount studs as shown in the drawing.
D. Stud holes to be kept absolutely free of rubber.

Acushnet solved the problem by molding rubber to the flange. This automatically compensated for depth tolerances. One piece mold cores provided with locating pins kept the stud holes free of rubber and produced the unusual contours needed within all tolerances.

Acushnet is ready to serve you with technical assistance on your next molded rubber and bonded-to-metal part. "APCOTITE" bonding to metal of all polymers is an Acushnet exclusive.

Specify "APCOTITE"!

Acushnet **ACUSHNET PROCESS COMPANY**
NEW BEDFORD, MASSACHUSETTS

... Precision Molded RUBBER, SILICONES - "APCOTITE" BONDING

Address all communications to 752A, Belleville Ave., New Bedford, Mass.

The most talked about and potentially the world's greatest deterrent to war the Inter-Continental Ballistic Missile "TITAN" now being developed by one of America's most select teams of scientists and engineers.

DENVER, the capitol of Colorado, has been selected by The Glenn L. Martin Co., to be the site of the multimillion dollar plant where this new field of engineering will be explored.

It is a permanent research undertaking that offers you the important advantages of quickly achieving professional recognition and advancement while working in an organization where you will have close association with other leaders in the field.

Colorful Colorado offers the ideal climate in which to live; a vacationer's paradise all year round; a chance to really enjoy living and do creative thinking.

Martin invites Aeronautical and Mechanical Engineers and Technicians and Physicists to share these advantages with them and asks you to . . .

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Rocket Propulsion	Aeronautical Engineering
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Stability and Control	Inertial Studies
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Equipment Design	Airframe—Missile Design

Address inquiries to: Emmett E. Hearn, Employment Director, Box 179, Dept. C-3, Denver, Colorado

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As an engineer at North American you get the full recognition of your profession. You work with engineers who respect your opinions and professional status. You enjoy individualism and team spirit—usually found only in small companies—and find a greater scope for your talents in the wider range of engineering fields offered at North American.

Take our supersonic F-100 SUPER SABRE as an example of what North American Engineering-Los Angeles has accomplished. But this is only a beginning. We have other planes under development which are being designed to fly still higher and at greater speeds. So if you want to put *your* skill and creative thinking to work on tomorrow's aircraft, we want to hear from you.

Immediate openings for these people—with or without aeronautical experience:

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Computer Programmers
Aerodynamicists
Metallurgists
Systems Engineers
Armament Engineers
Electrical Designers
Power Plant Engineers
Structures Engineers
Electronics Engineers
Mechanical Engineers
Controls Engineers
Wind Tunnel Engineers
Servomechanism Engineers
Instrumentation Engineers
Weight Control Engineers
Aero Thermodynamicists
Research Physicists
Aeroelasticity Engineers
Rubber Compounding Engineers
Vibration & Flutter Engineers
Structural Loads Engineers
Structural Analysts
Structural Tests Engineers
Structural Designers
Flight Test Engineers (work at Los Angeles or Palmdale, Calif.)

Write: Les Stevenson, Engineering Personnel, Dept. 56, ME
North American Aviation, Inc., Los Angeles 45, California

North American Aviation, Inc. is doing research and development on a manned aircraft, the X-15, for investigation of high-altitude, speeds and temperatures.

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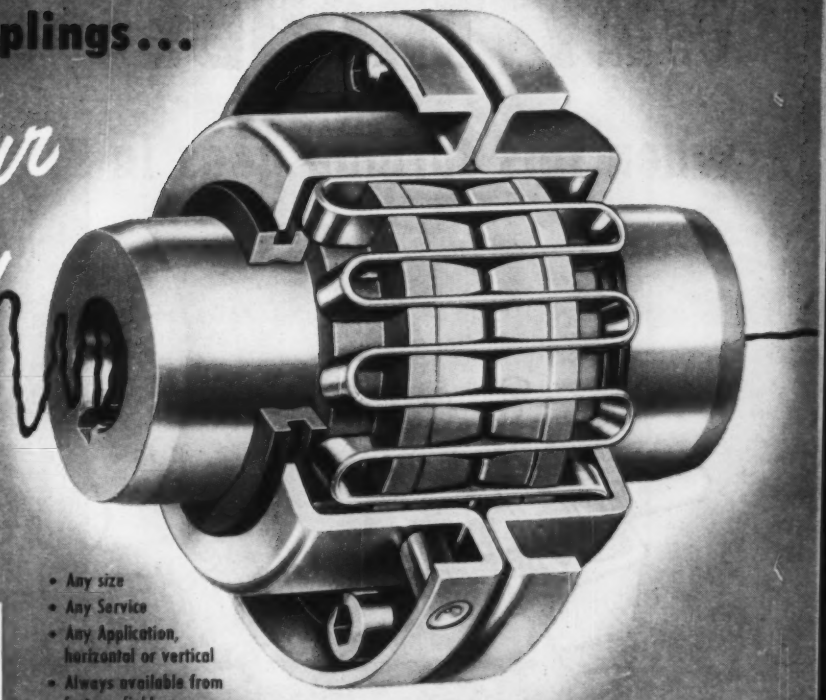
Falk Steelflex Couplings...

Protect your machinery in 2 ways



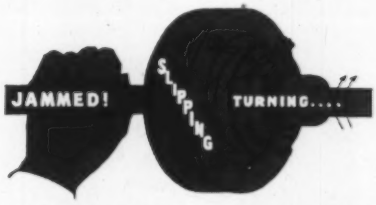
- Any size
- Any Service
- Any Application, horizontal or vertical
- Always available from factory, field or distributor stocks

Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance... are easy to install, lubricate and disconnect... and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

FALK

...a good name in industry

MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
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- Special Gear Drives
- Single Helical Gears
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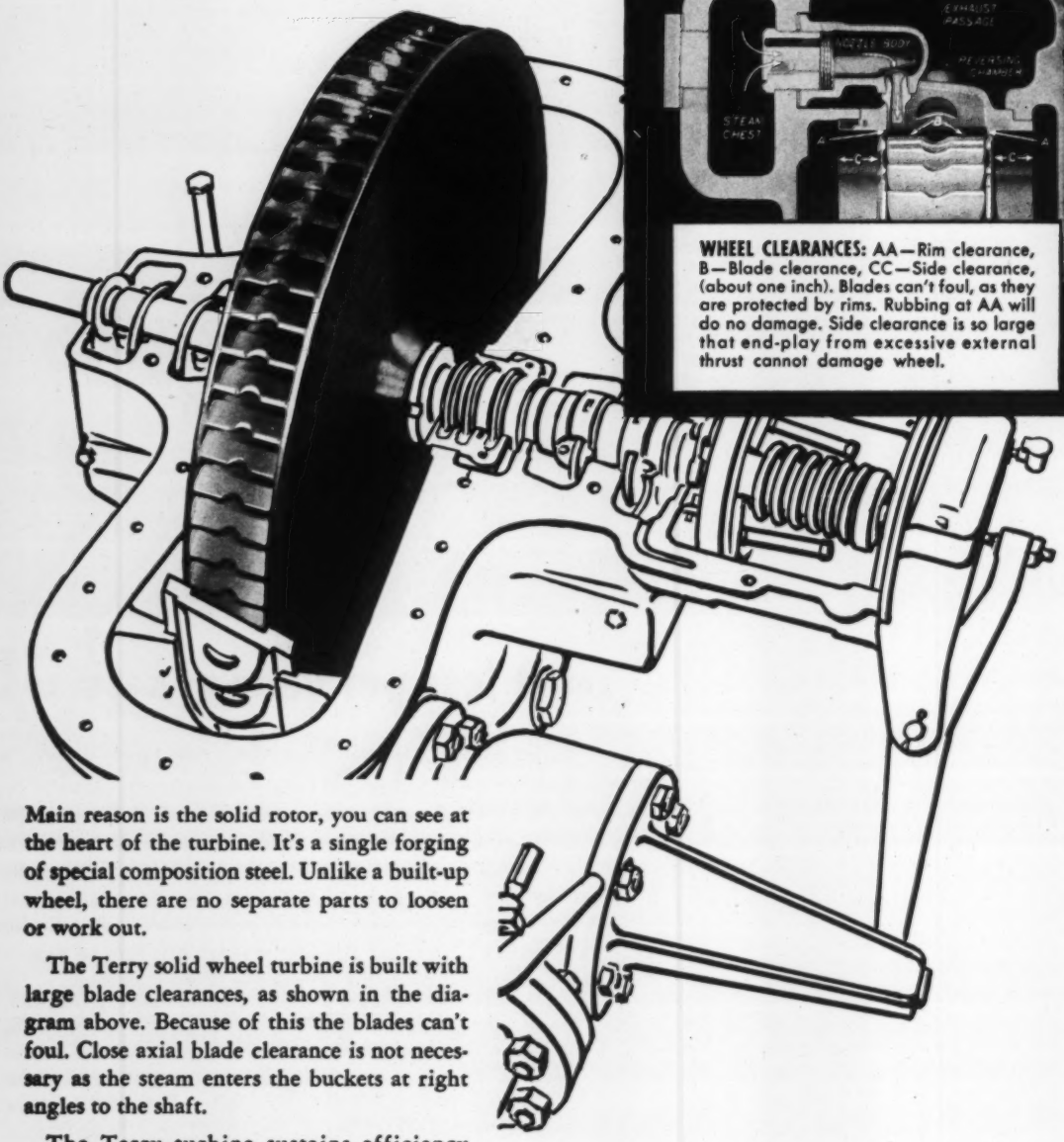
- Steel Castings
- Weldments
- Contract Machining

WHY TROUBLE GOES OUT

when this turbine goes in

WHEEL CLEARANCES: AA—Rim clearance, B—Blade clearance, CC—Side clearance, (about one inch). Blades can't foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



Main reason is the solid rotor, you can see at the heart of the turbine. It's a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out.

The Terry solid wheel turbine is built with large blade clearances, as shown in the diagram above. Because of this the blades can't foul. Close axial blade clearance is not necessary as the steam enters the buckets at right angles to the shaft.

The Terry turbine sustains efficiency through the years. Reason: The power producing action of the steam takes place on the curved surfaces at the back of the buckets, so blade wear which might occur is of little consequence.

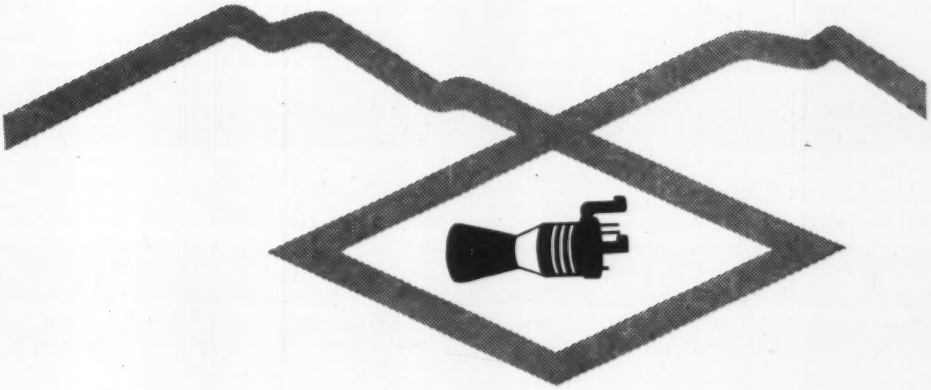
Bulletin S-116 tells more about these *"Work Horses of Industry."* Send for a copy today.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1282

GOOD NEWS FOR TURBINE SPECIALISTS



If you are a turbine specialist, turbomachinery engineer—or interested in any phase of the design, development testing or manufacture of large, liquid-propellant rocket engines—we can offer you some outstanding job opportunities.

We are one of the country's leading manufacturers of rocket engines for the Armed Services and the missile industry, with a 10 year backlog of experience in all phases of rocket engine development and manufacture.

New engine designs, new pumps and the powerful turbines to drive them, and the testing of completed engines to meet the rugged requirements of space flight are just some of the interesting phases of our work.

What's more, we offer you the added attraction of working and living in the beautiful San Fernando Valley in Southern California. It's to your advantage to write immediately.

Thermodynamicists—To analyze and develop high speed, subsonic and supersonic turbines. Aircraft jet engine or industrial steam turbine experience desired.

Turbomachinery Engineers—To work on the analysis, design and development of high speed rotating machinery. Openings are available for specialists in Gearing, Bearings, Rotating Seals, Subsonic and Supersonic Turbines, Centrifugal and Axial Flow Pumps and related mechanical activities.

Analytical and Experimental Development Engineers—With background in Thermodynamics, Aerodynamics, or Hydrodynamics, to work on subsonic and supersonic turbines, radial and axial flow pumps and other problems associated with high speed rotating machinery.

Engineers—Mechanical and Aerodynamic Engineers with experience on compressors, turbines, high speed axial flow and centrifugal pumps for analysis, design and experimental development work on high speed turbomachinery.

General Mechanical Design of components of high speed rotating machinery such as gears, bearings, rotating seals, hydraulic drives and transmissions, turbines and pumps.

Hydrodynamicists for analytical and experimental development work on centrifugal and axial flow pumps.

Aerodynamicists and Thermodynamicists for analytical and experimental development work on high speed subsonic and supersonic turbines.

Stress Analysts with experience on high speed turbomachinery. Background in gas turbine and jet engines preferred.

Write Mr. Grant Baldwin, Rocketdyne Engineering Personnel, Dept. 596ME, 6633 Canoga Ave., Canoga Park, Calif.

ROCKETDYNE

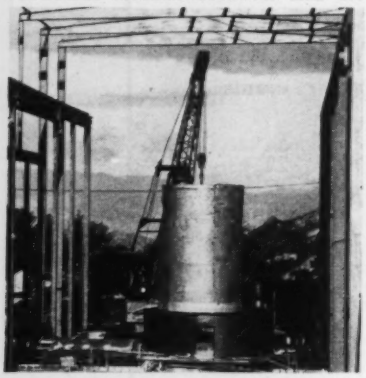
A DIVISION OF NORTH AMERICAN AVIATION, INC.

BUILDERS OF POWER FOR OUTER SPACE

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Principal Technical Details of the Sodium Reactor Experiment in California

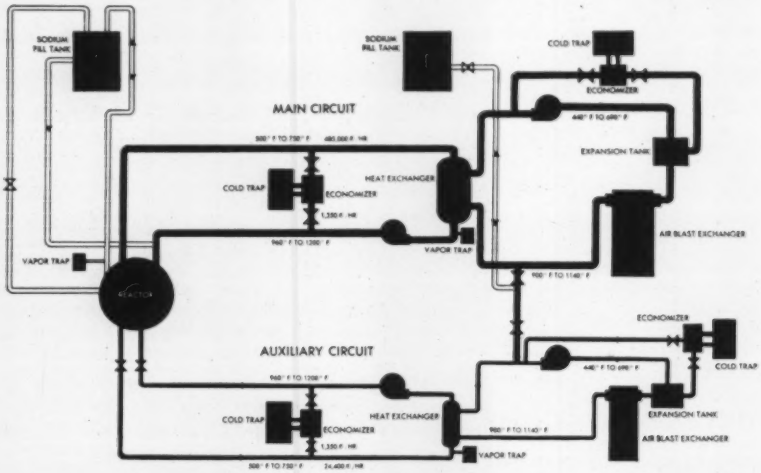
The Sodium Reactor Experiment is an important contribution to the Atomic Energy Commission's program to develop economical power from nuclear energy. Interest in the SRE approach is high. The Atomic Energy Commission has authorized ATOMICS INTERNATIONAL and the Southern California Edison Company to enter into an agreement for Edison to install electrical generating equipment with a capacity of 7,500 kilowatts adjacent to the SRE to convert the reactor's 20,000 kilowatts of heat into electricity which will be fed into the utility's power grid system. ATOMICS INTERNATIONAL and the



SRE reactor core is lowered into place deep in the Santa Susana Mountains

Consumers Public Power District of Nebraska are negotiating for the construction of a 75,000 kilowatt nuclear power plant utilizing a sodium graphite reactor based on SRE experience.

The Sodium-Cooled, graphite-moderated reactor design has many advantages. The use of sodium permits high temperature operation, good steam conditions and high thermal efficiency of power conversion without pressurization of the reactor and coolant circuit. The high thermal conductivity of sodium makes it an excellent heat transfer medium. Sodium boils at 1620°F.—is liquid at 208°F. This permits high coolant temperatures with the system at atmospheric pressure, creating a low-pressure heat extraction system which simplifies reactor construction. Further, the sodium design minimizes chemical reaction between fuel elements, coolants and structural materials—increases safety—allows the use of a variety of steels and alloys in construction.



Sodium Flow Diagram For SRE Cooling System

Nominally Rated Output of SRE with Uranium fuel (enriched with 2.80 atom percent U235) is 20 Thermal Megawatts. The reactor core is made up of fuel rods, moderator cans and control elements interspersed and immersed in sodium coolant. The fuel is composed of 6 inch slugs, 0.750 inches in diameter, formed in 6 foot columns tied in clusters of seven. The graphite moderator elements are canned in Zirconium, fabricated with an axial coolant channel. This prevents absorption of sodium into graphite. Much less costly than beryllium—graphite is also comparatively easy to handle.

Capital and Power Costs in Full Scale Power Stations—At present, with Uranium fuel, capital costs/ installed Kw. are expected to total $300. With Thorium, costs may be $265/installed Kw. Power costs (based on 80% load factor and 15% annual fixed charges) may be 11 mills/kwh with Uranium, 9 mills with Thorium. Future costs with Thorium fuel are expected to be $200/Kw capital cost and 6.5 mills/kwh total power costs.

Atomics International is a major reactor builder—experienced in the design, construction and operation of nuclear reactors for research and the production of power. If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Applications Engineering Service, Dept. ME-N2, ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, California. Cable address: ATOMICS.

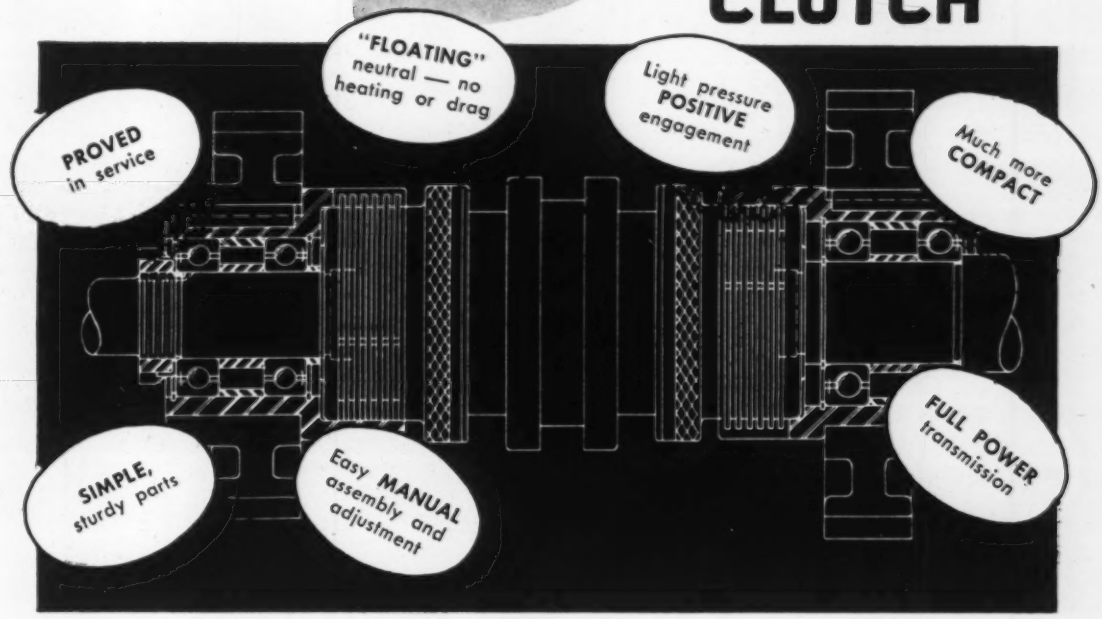
ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

BUILD INTO YOUR PRODUCT THE TROUBLE-FREE PERFORMANCE OF A

MAXITORQ

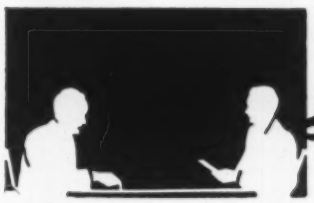
floating disc

CLUTCH


"FLOATING" neutral — no heating or drag
Light pressure POSITIVE engagement
PROVED in service
Much more COMPACT
FULL POWER transmission
SIMPLE, sturdy parts
Easy MANUAL assembly and adjustment

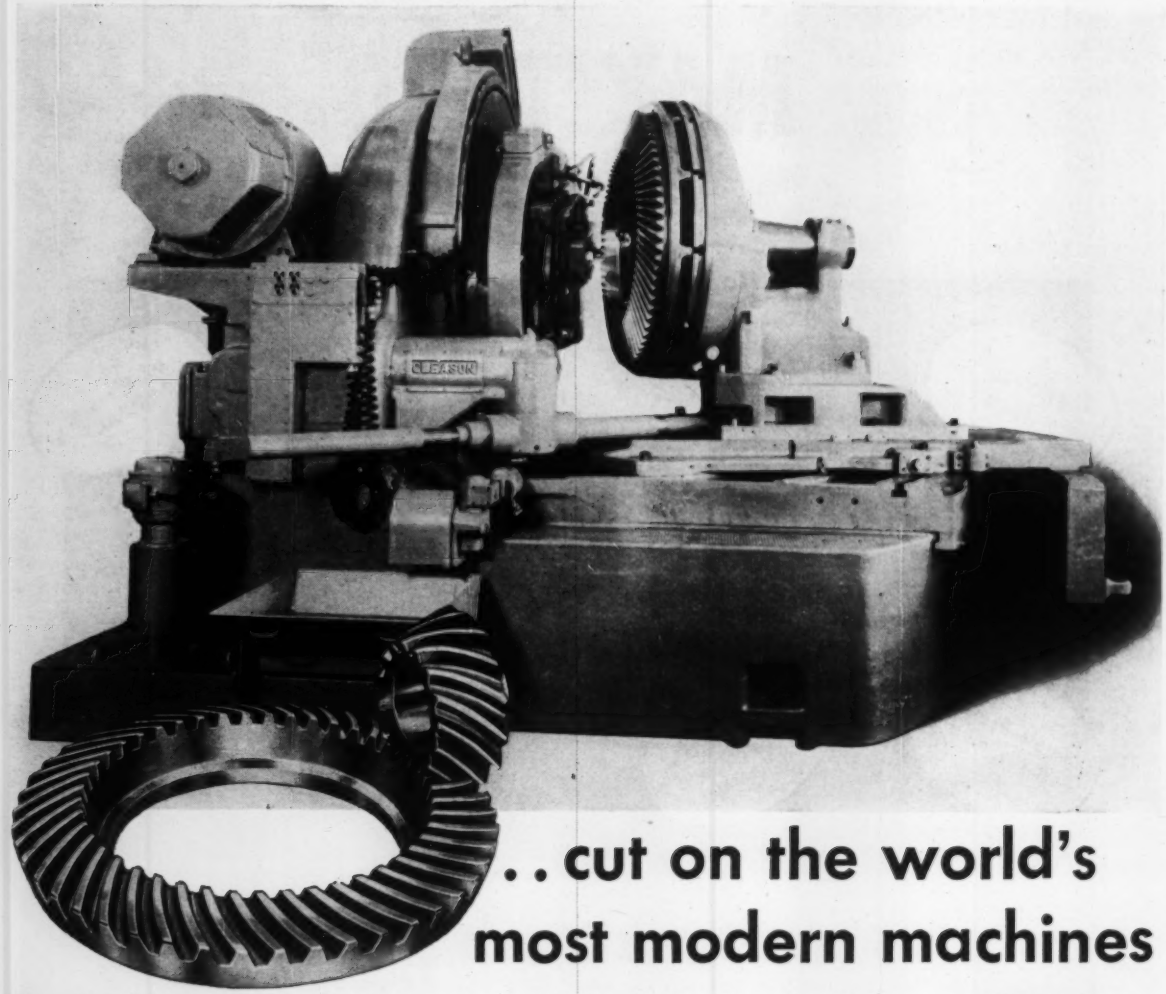
Here is an example of the simple, rugged, and compact installation possible with a MAXITORQ Double Clutch, with pulley-type driving cups, as the speed-change control between high and low-speed gears. Since MAXITORQ clutches, because of their exclusive design features, are always quick and positive in action while at the same time completely free in neutral, this type of installation has a well-proved record of performance to recommend it.

Other types of MAXITORQ Floating Disc Clutches . . . single, double, and overload release . . . are available in a wide range of stock sizes to meet the needs of a great many installations. Our engineering department also stands ready to help you with special drive problems. Write or phone Dept. ME-5. The Carlyle Johnson Machine Company, Manchester, Conn.



Let's talk **MAXITORQ**

NOW spiral-bevels up to 72" diameter, 10" face width



. . cut on the world's most modern machines

Our addition of a new #70 Gleason Generator assures the widest possible selection of Spiral-Bevel Gear diameters and face widths available anywhere—diameters up to 72"; face widths to 10". Even in these massive sizes, accuracy of tooth shape, and precision of gear and pinion operation are assured.

Acquisition of this modern, new machine is another step in keeping Phillie Gear one of the world's best equipped, largest and most progressive gear manufacturing plants.

Regardless of the type, size or quantity of gears needed, you are assured of Quality, Service, Delivery and Courtesy, when you call upon Phillie Gear—world leader in gear manufacturing—with nearly 65 years experience.

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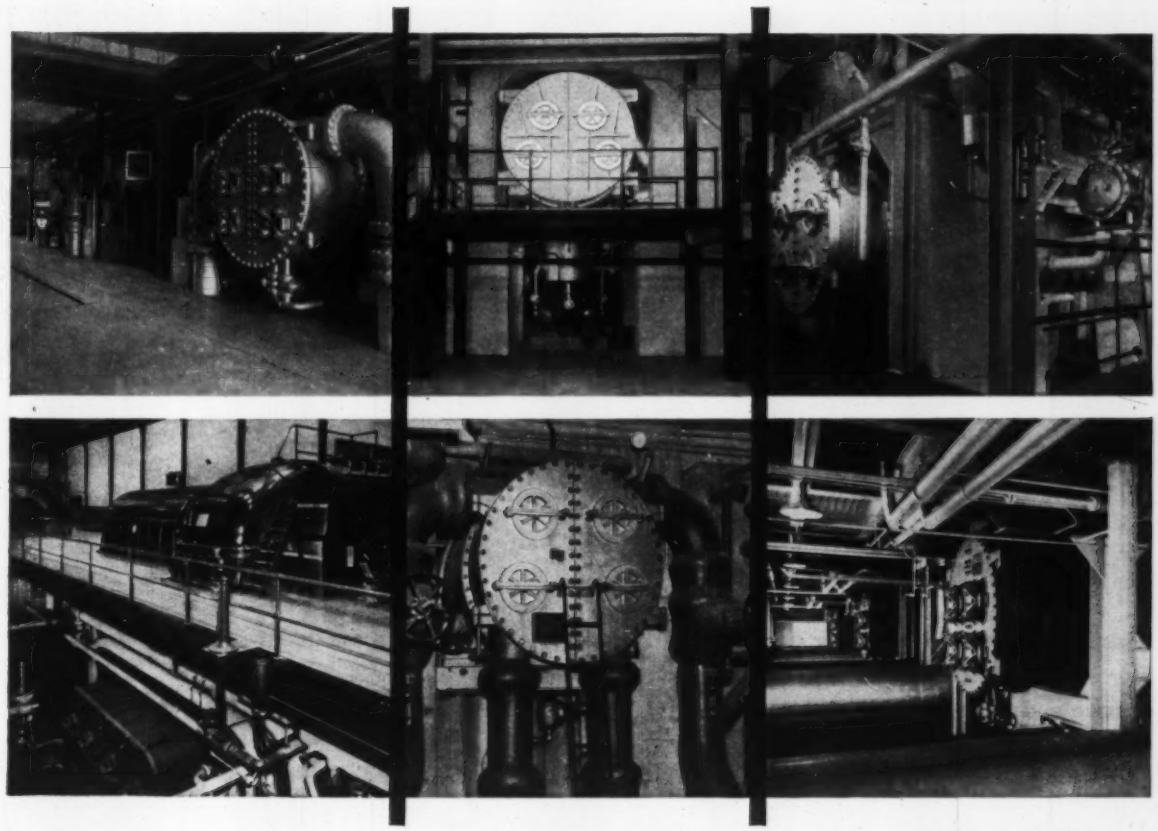
ROSS SURFACE CONDENSERS

serve power plants everywhere



Pre-eminence of Ross engineering and manufacturing has won many customers . . . and kept them . . . here and abroad.

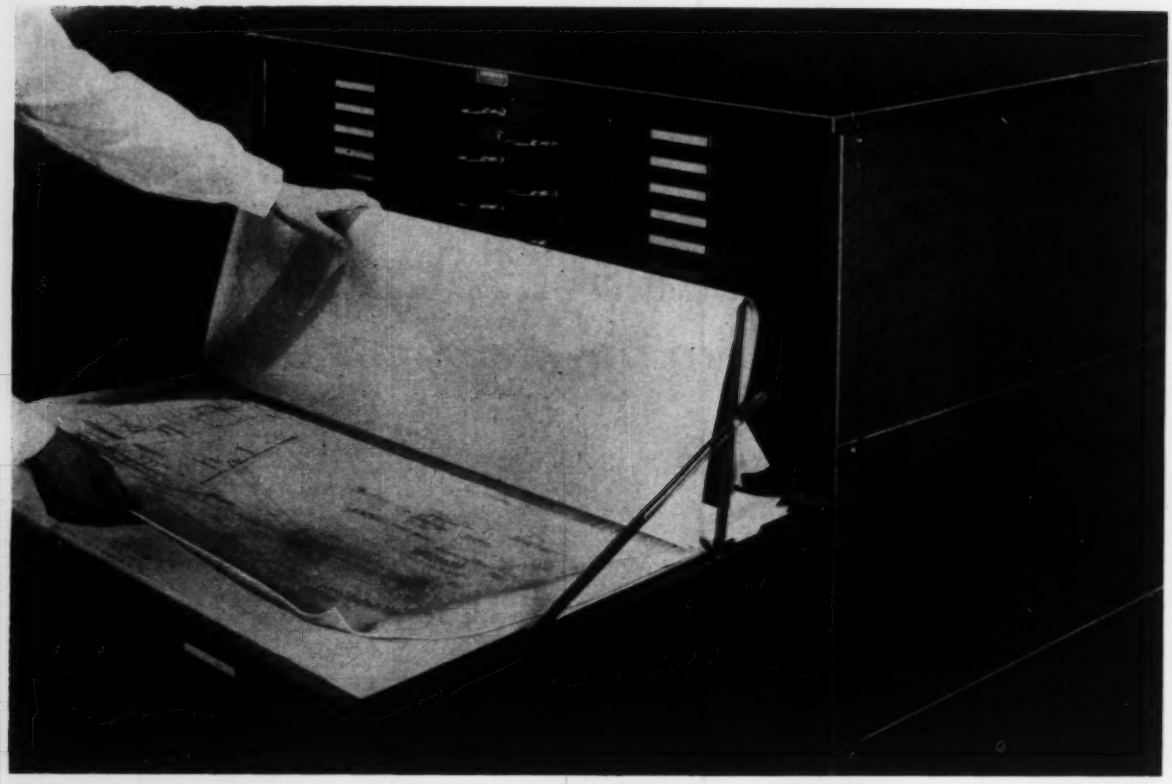
Public utilities, municipalities, industries, institutions, office buildings . . . some equipped with large twin bank designs, others with smaller single bank units . . . number among Ross installations which date back 40 years.

Long a leading, exclusive producer of heat exchange and condensing equipment . . . long a pace-setter with major innovations . . . Ross has a versatile experience to offer in the interpretation *and fulfillment* of your requirements. Consulting engineers, contractors, architects or plant men . . . whoever specifies . . . all like to work with Ross engineers in the solution of condensing and heat exchange problems.

New Bulletin 8.2K1 gives you the reasons why. Write for your copy, please. Ross Heat Exchanger Division of American-Standard. 1448 West Ave., Buffalo 13, N. Y. In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

ROSS

ROSS HEAT EXCHANGER PRODUCTS



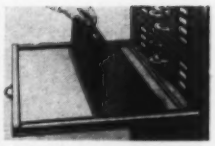
1000 tracings... all easily accessible ... in 15⅜ inches!

This Hamilton Shallow-Drawer unit, only 15⅜" high, safely stores 1000 of your most active tracings. Yet you can easily remove and refile any one of them because of the exclusive *tracing lifter* in each drawer.

Hamilton builds outstanding units for every storage need. Many units interlock in a single, compact UnitSystem to give you a variety of special purpose filing units in a single-bank assembly. See your Hamilton dealer or write for complete UnitSystem information.

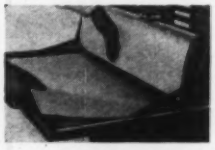
Keeps contents flat

Each drawer has a mechanical tracing lifter that also keeps contents flat when drawer is closed.



To find drawing

Raise front half of tracing lifter and locate desired drawing. Rear half still holds contents firmly.



Removing sheet

Sheets above desired drawing are turned over lifter and folded back. Sheet is easily removed.

Refiling sheet

Drawing is refiled as easily as removed—flat and smooth, ready for many future references.

Many Hamilton units (5-Drawer, Shallow-Drawer, Vertical Drawer) interlock into a single UnitSystem installation—building storage space *upward*, saving floor space. UnitSystem equipment is available in sizes to fit your filing requirements.

Hamilton

DRAFTING EQUIPMENT

HAMILTON MANUFACTURING COMPANY • TWO RIVERS, WISCONSIN

STRONGER and SAFER for every high pressure pipeline duty...

...because they are **drop forged** *by*

Vogt

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Constantly imitated but never duplicated, Vogt drop forged steel fittings and flanges have unmatched strength and toughness for your most severe pipeline duties. Laboratory controlled materials and Vogt's special forging techniques assure products which are always uniform in structure, fine grained, and free from porosity. Thereby the shocks and stresses imposed by high pressures and high temperatures are easily withstood, and with stubborn resistance to erosion and corrosion. Consult Catalog F-9 for our complete line of fittings and flanges.

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SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati, San Francisco

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✻ **Because you'll need greater print-making capacity to meet the push for more drafting room output!**

✻ **Because your old reproduction unit can't keep pace with increased demands!**

✻ **Because, with management's desire for greater production, you can get top level approval for new equipment!**

NEW COPYFLEX MODEL 500

A new, ultra-fast, heavy-volume machine offering top mechanical speed of 40 f. p. m., automatic separation, front or rear delivery, automatic stacking, and a host of other advanced features.

You Need It! The boom in production means more pressure than ever for engineering prints. Modern Copyflex will help you deliver them! New, better-than-ever models bring you faster reproduction speed and a host of operator conveniences to step up production.

You Want It, Surely! Take this opportunity to replace that old, inadequate unit with efficient, trouble-free Copyflex—no exhaust venting, no plumbing or auxiliary equipment, no installation other than an electrical connection.

You Can Get It! Chances are that your firm, like most others, is gearing up for greater-than-ever production. You couldn't pick a better time to include new, higher-production equipment in your program. There's a new, improved Copyflex model to suit every price and production requirement. Mail coupon today. You'll be glad you did!

Three Other New, Improved Copyflex Models

Model 250. Newest and finest of its size. Takes less than a sq. yd. of floor space. Up to 25 f.p.m. speed —18½" printing width. Automatic stacking and separation.

Model 35. Provides up to 30 f. p. m mechanical speed and a full 46-inch printing width for heavy volume reproduction—at a thrifty, low price.

Model 100. The helper your big machine needs. Makes up to 300 prints of one or many different 8½" x 11" originals per hour—at less than 1¢ each for materials.

BRUNING Copyflex

Best Process! Best Machines! Best Selection of Materials!

Specialists in Copying Since 1897

CHARLES BRUNING COMPANY, INC., 4700 Montrose Ave., Chicago 41, Illinois

In Canada: Charles Bruning Company (Canada) Ltd., 105 Church St., Toronto 1, Ont.

Charles Bruning Company, Inc., Dept. 53-N
4700 Montrose Ave., Chicago 41, Illinois

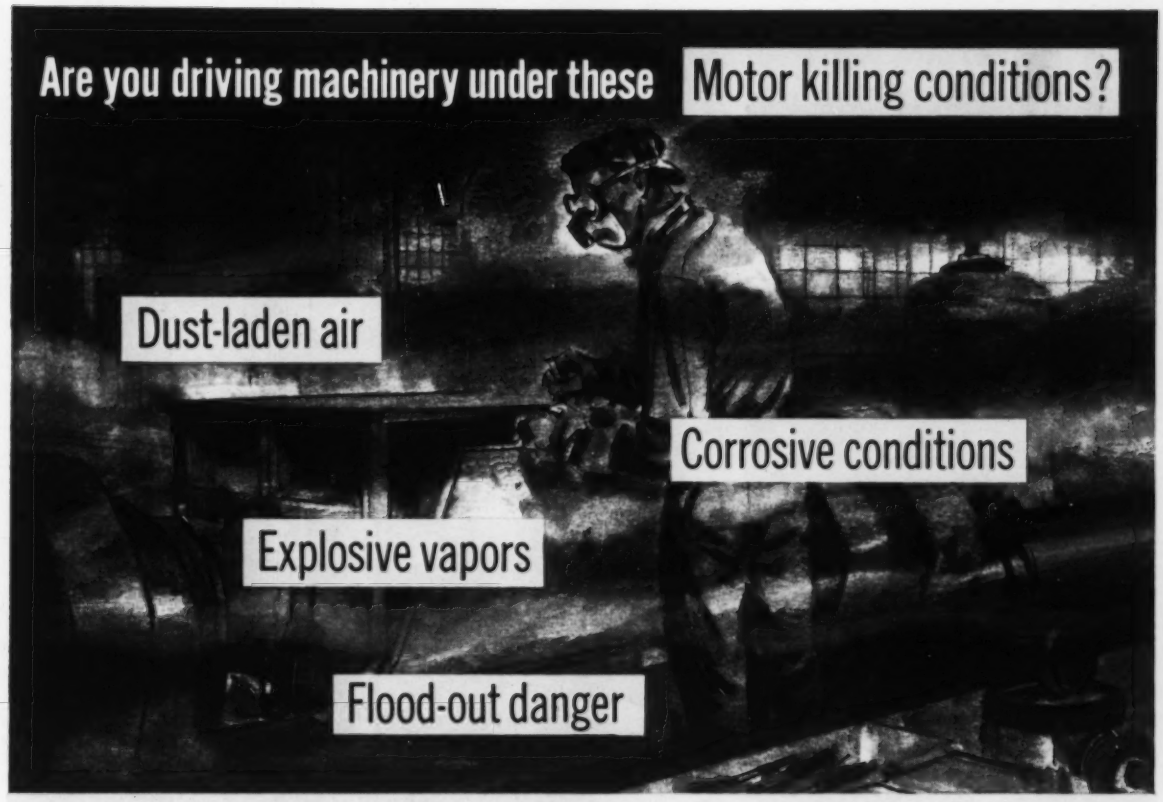
Please send me information on Copyflex process and ____Model 500 ____Model 250 ____Model 35 ____Model 100.

Name _____ **Title** _____

Company _____

Address _____

City _____ **County** _____ **State** _____



This New BJ Mechanical Drive Motor solves these problems!

Where difficult operating conditions make the use of a conventional open-wound motor either extremely impractical or hazardous, your best answer is the BJ Mechanical Drive Motor. Designed for the most rigorous use, this totally enclosed motor is filled with oil and mechanically sealed to make it impervious to *any* external condition. There is no possibility of sparking, corrosive attack, flooding out or "loading up." If you are driving machinery in mining, milling, refining or other industrial applications where these "motor killing" conditions exist you owe it to yourself to investigate the BJ Mechanical Drive Motor. It is a proven product of Byron Jackson's more than 20 years experience in the design and manufacture of oil-filled, sealed electric motors.

The BJ Mechanical Drive Motor is available in sizes from 5 to 450 HP, 4 pole, and can be supplied to meet the special torque or horsepower and speed requirements of any particular application. *Write for special BJ Mechanical Drive Motor information.*

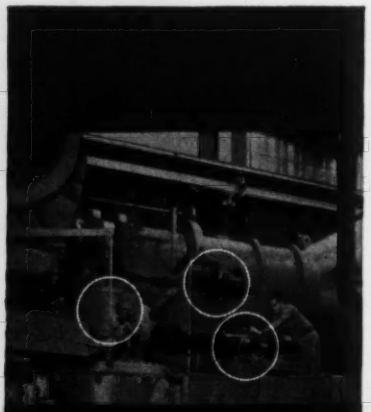
BJ

Byron Jackson

Division of Borg-Warner Corporation

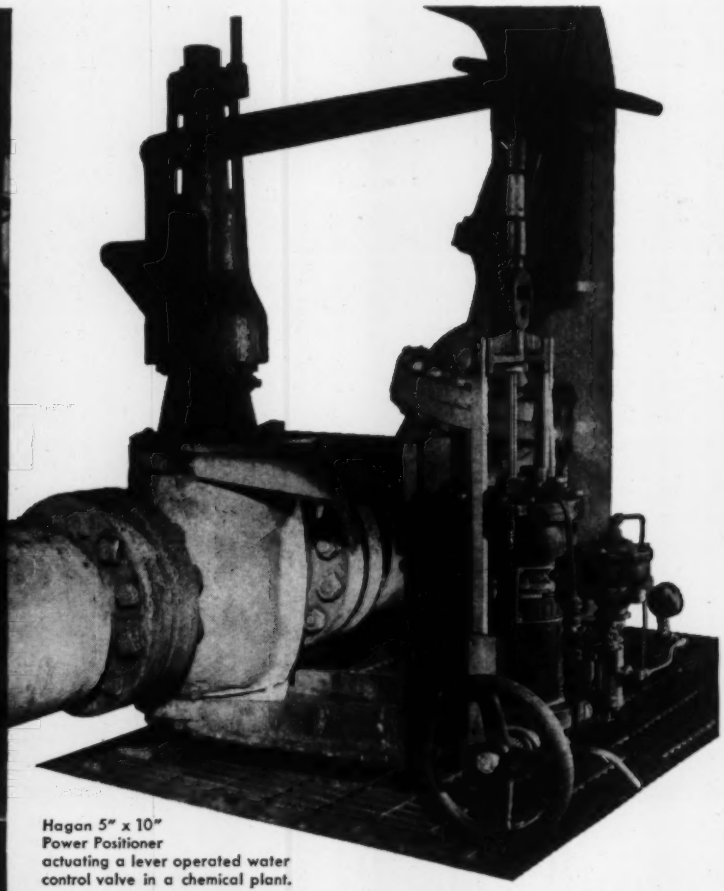
P. O. Box 2017A, Terminal Annex

Los Angeles 54, California



Two 8" x 20" and one 5" x 20" Hagan Power Positioners operating plug valves on a wind tunnel in an aeronautical test facility.

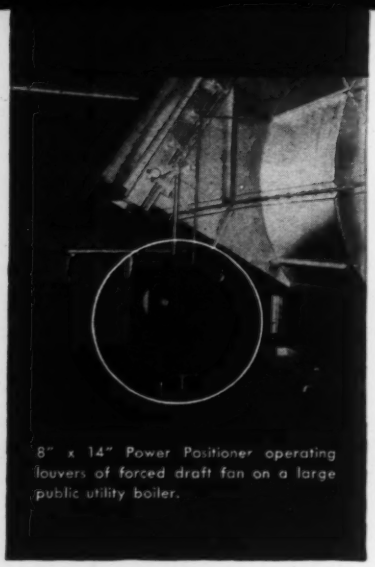
Louvers on forced draft fans operated by Hagan 6" x 10" Power Positioners. Note outdoor installation.



Hagan 5" x 10" Power Positioner actuating a lever operated water control valve in a chemical plant.

HAGAN POWER POSITIONERS

HIGH PRECISION—LOW MAINTENANCE!



8" x 14" Power Positioner operating louvers of forced draft fan on a large public utility boiler.

Hagan Power Positioners provide the "muscles" for thousands of control applications in every type of industry—wherever torque and positioning accuracy requirements are severe.

Hagan Power Positioners are economical, both in first cost and in the low maintenance costs which result from their uncomplicated design and strong construction. Many Hagan units are still giving trouble-free, dependable service after years of exposure to rigorous conditions, such as high ambient temperature (up to 160°), corrosive atmospheres, or outdoor installations.

Hagan Power Positioners can help you lower costs in all your final power drive needs. Write for Specification File TP-MFI for information on the full range of these powerful "Muscles for Industry."

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN

Systems and Components for: Boiler Combustion Control, Metallurgical Furnace Control, Process Control, Aeronautical Testing Facilities • Industrial Water Treatment • Chemicals for Water Conditioning

HAGAN SUBSIDIARIES: CALGON, INC. • HALL LABORATORIES, INC.

Rugged seal for a Rambler

LOCKS E. P. LUBE IN FOR A FAST PINION

In the dashing, new Rambler, the rear pinion may turn up to 3800 rpm—and, on a hot day, lube temperature may run 250° or more . . . and it is vital that the E.P. lubricant protecting this pinion be retained under all operating conditions. American Motors posed this key problem to Chicago Rawhide: provide a pinion seal that would more than withstand the temperature involved, and equally important, resist the deteriorating effects of a high sulphur content in E.P. lubricants. C/R engineers recommended the new C/R Type W Oil Seal. Result: this unique seal is delivering positive, dependable sealing performance under the most rugged road conditions.

Do you have a difficult sealing problem? C/R engineers will welcome the opportunity to work with you in the selection of the correct seal style and material for your application. Write for detailed information.

More automobiles, farm and industrial machines rely on C/R Oil Seals than on any similar sealing device.

CHICAGO RAWHIDE MANUFACTURING COMPANY
1229 Elston Avenue • Chicago 22, Illinois

Offices in 55 principal cities. See your telephone book.

In Canada: Manufactured and Distributed by Super Oil Seal Mfg. Co., Ltd., Hamilton, Ontario

Export Sales: Geon International Corp., Great Neck, New York

OIL SEAL C/R DIVISION
CHICAGO RAWHIDE

Other C/R Products

Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears

ENGINEERS...

LOOK TEN YEARS AHEAD!

Will your income and location allow you to live in a home like this... spend your leisure time like this?

A Douglas engineer lives here

They can...if you start your career now at Douglas!

Take that ten year ahead look. There's a fine career opportunity in the engineering field you like best waiting for you at Douglas.

And what about the Douglas Aircraft Company? It's the biggest, most successful, most stable unit in one of the fastest growing industries in the world. It has giant military contracts involving some of the most exciting projects ever conceived . . . yet its commercial business is greater than that of any other aviation company.

The Douglas Company's size and variety mean that you'll be in the work you like best—side by side with the men who have engineered the finest aircraft and missiles on the American scene today. And you'll have every prospect that ten years from now you'll be where you want to be career-wise, money-wise and location-wise.

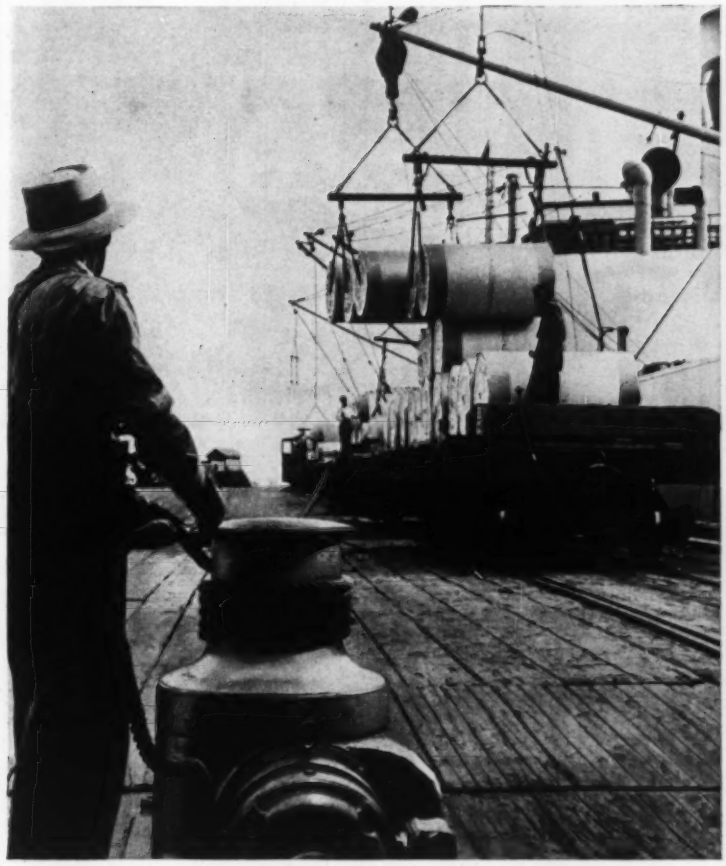
For further information about opportunities with Douglas in Santa Monica, El Segundo and Long Beach, California divisions and Tulsa, Oklahoma, write today to:

DOUGLAS

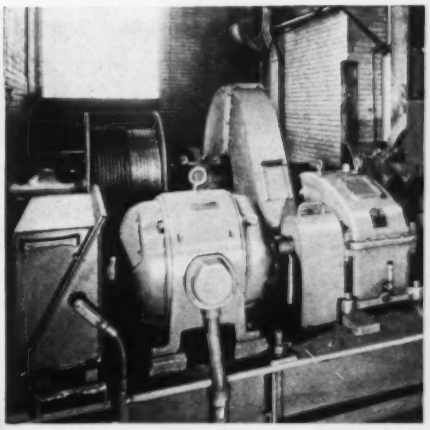
First in Aviation

DOUGLAS AIRCRAFT COMPANY, INC.

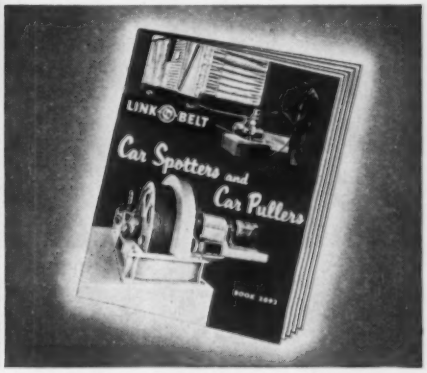
C. C. LaVene, 3000 Ocean Park Blvd., Santa Monica, California



CAR SPOTTERS utilize a vertical capstan, helical and worm gear drive, heavy housing and a 5- or 10-hp motor. Available in portable and stationary models, they also move heavy vehicles, skids, barges, etc.



DRUM-TYPE PULLERS are made in single and double drum models, including designs for long hauls and extreme loads.



BOOK 2092 contains engineering information, instructions for calculating rope pulls and typical layouts for spotters and pullers.

There's less wait for freight

when Link-Belt car spotters or drum-type pullers speed loading and unloading, save demurrage charges

THE need for fast spotting of railroad cars is a problem common to most industries. Conventional methods tie up both yard crews and cars . . . make the job slow and costly. Needlessly so.

For every car positioning need, there is a Link-Belt machine built and sized right . . . able to repay its cost in demurrage and manpower savings. Car Spotters permit a single operator to move up to six loaded cars with a few quick turns of rope around the capstan. Two sizes of motors—which can be mounted integral or separate—give him five- or ten-thousand pounds of rope pull. And for extremely large loads, horizontal drum pullers offer far greater capacities.

If your plant has a railroad siding, review your car moving operations with an eye toward mechanization with a Link-Belt car spotter or puller. For helpful literature, write LINK-BELT COMPANY, Dept. AV, Prudential Plaza, Chicago 1, Ill.

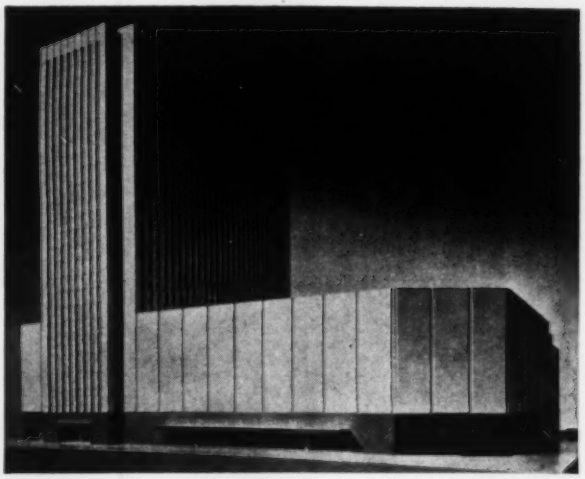
LINK-BELT

14,050

One source . . . one responsibility

for materials handling · power transmission · processing machinery

Everybody's talking about
New York's great new
exposition hall—
The Coliseum!



ONE OF YOUR BIGGEST SALES OPPORTUNITIES WILL BE JUST 4 MINUTES FROM TIMES SQUARE AT THE . . .

22nd NATIONAL EXPOSITION of POWER & MECHANICAL ENGINEERING

Under auspices of ASME

COLISEUM – NEW YORK – NOV. 26-30, 1956

Here's one of the greatest sales opportunities in decades for hundreds of manufacturers! It's the initial POWER SHOW at New York's fabulous new COLISEUM!

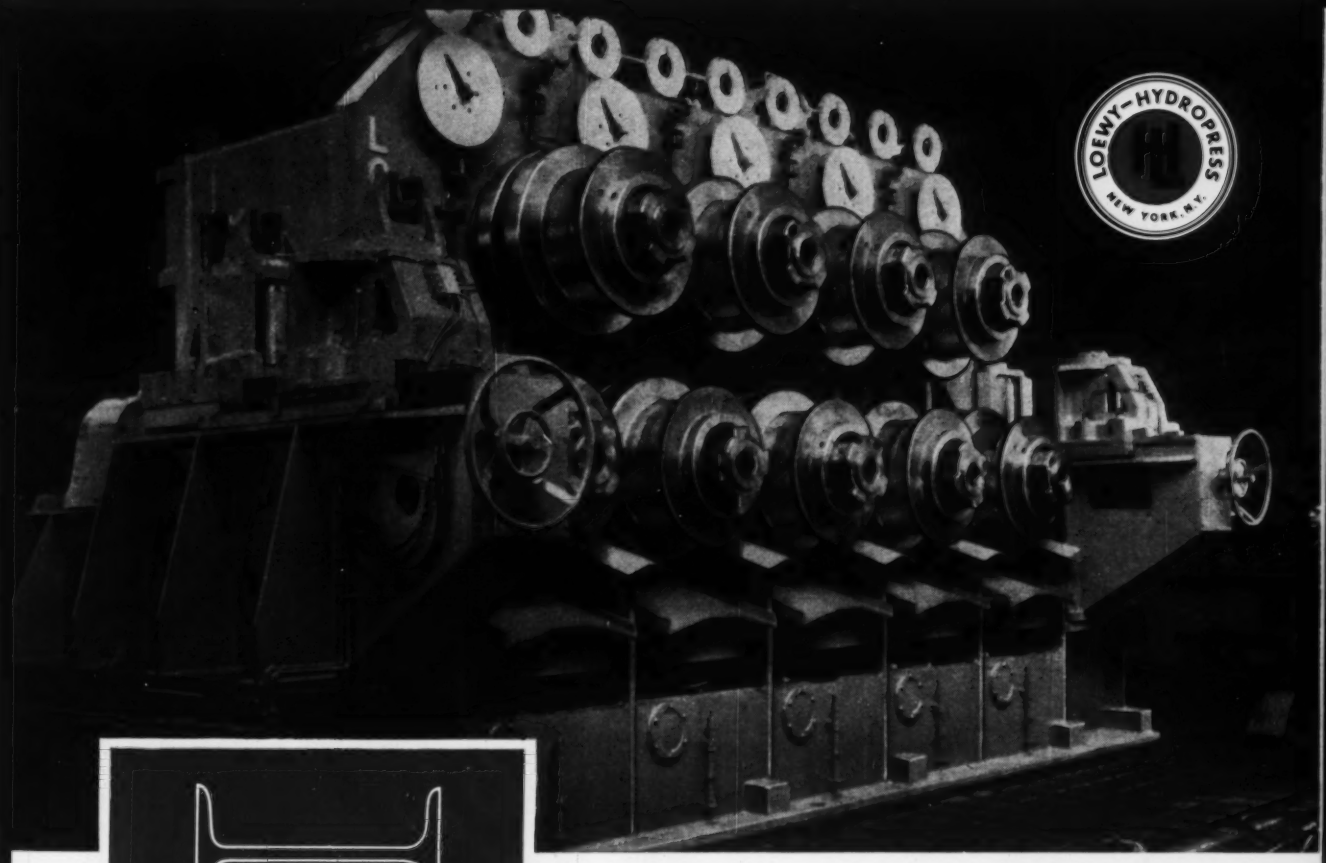
Now—in the very center of New York—hundreds of your best customers and prospects will be anxious to learn, *first hand*, about new developments in power and allied equipment. Vitally interested engineers and key operating personnel will be seeing New York's first POWER SHOW in four years . . . and in a new, more comfortable atmosphere. Every modern facility, including air conditioning, will keep visitors in a relaxed, receptive, *buying* frame of mind.

This is one fact-filled exposition you can't afford to miss . . . as an exhibitor. It will help you build acceptance with those markets you've been trying to reach, by showing your products, and supplying vital engineering data in the most effective possible way.

Capitalize on this prime selling opportunity! Exhibit space may soon be at a premium—write now for full particulars.

22ND NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING

MANAGEMENT: **INTERNATIONAL EXPOSITION CO., 480 Lexington Avenue, New York 17, N. Y.**



new LOEWY roller straightener produces more tonnage to closer tolerances

Structural sections, sheet pilings, wide flange beams and heavy rails can be straightened to tolerances well above commercial standards with the new 1956 Loewy roller straightener. This efficient machine operates at speeds up to 500 FPM, and its production capacity is high, i.e. 20 lb. beams can be straightened at the rate of 1,320 tons per 8 hour shift and 73 lb. beams at the rate of 2,200 tons per 8 hours.

Other advantages you get with this new Loewy straightener are:

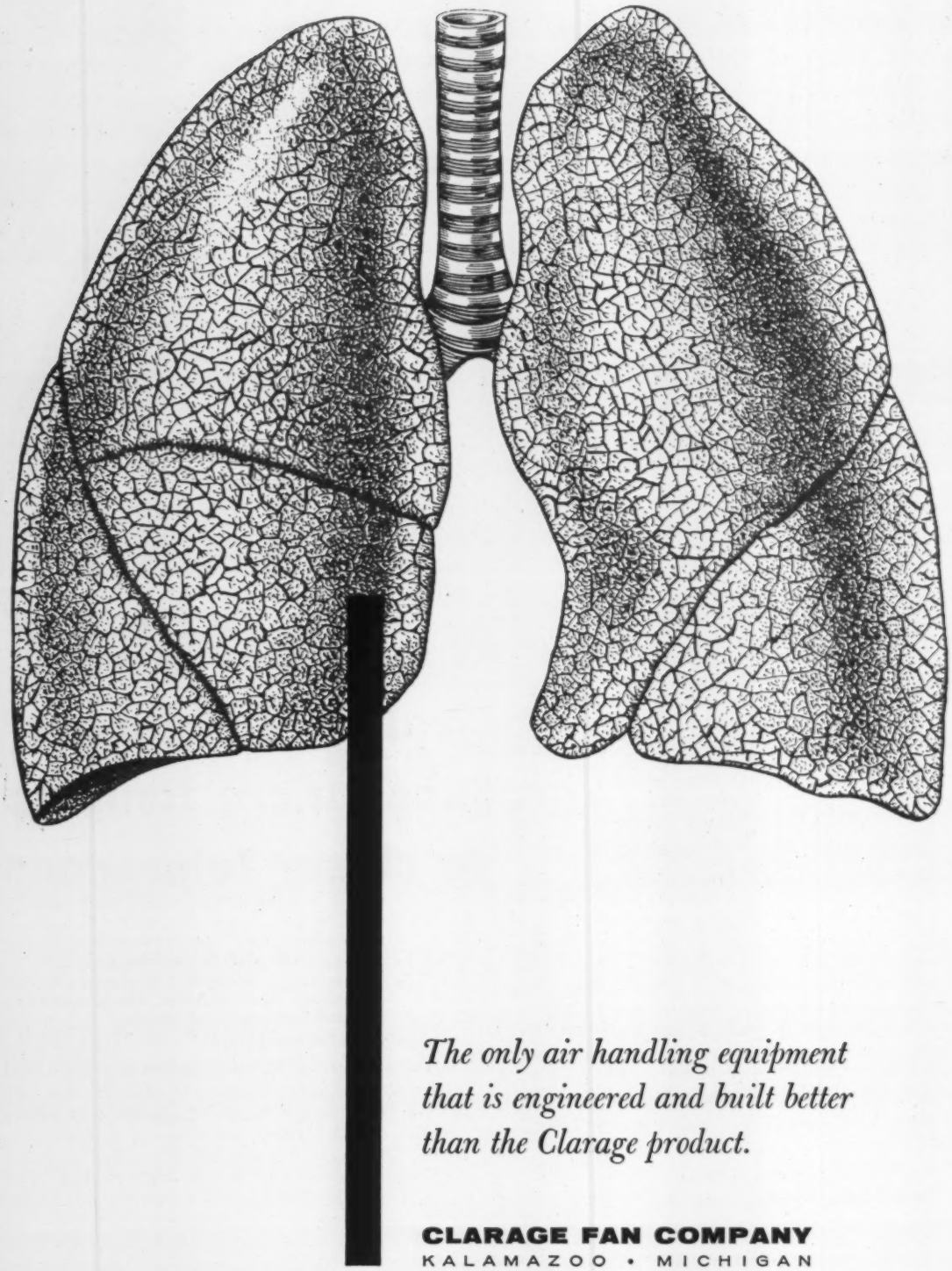
- **All welded rigid construction.**
- **Anti-friction bearings throughout.**
- **Motor driven, power operated vertical rollers supported on both sides in roller bearings.**
- **Remote control of vertical and horizontal roll adjustment, with accurate selsyn indicators mounted conveniently on pulpit.**
- **Quick roll changing.**

Loewy roller straighteners are in use in modern steel mills in the United States and abroad. The new model 1956 offers so many advantages over earlier designs that it is truly *"the design of tomorrow . . . today."* For more information about this precision equipment, write to us at 561 Fifth Avenue, New York 1, N. Y.

BALDWIN BLH LIMA-HAMILTON

LOEWY-HYDROPRESS
BALDWIN-LIMA-HAMILTON

DIVISIONS: Austin-Western • Eddystone • Electronics & Instrumentation • Hamilton • Lima • Loewy-Hydropress • Madsen • Pelton • Standard Steel Works



The only air handling equipment that is engineered and built better than the Clarage product.

CLARAGE FAN COMPANY
KALAMAZOO • MICHIGAN

Office with concealed piping, only the heads showing

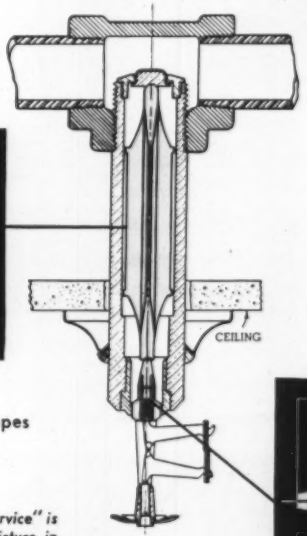
REVERE Extruded Shapes

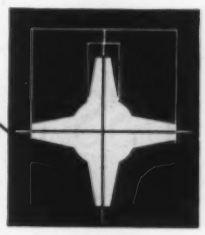
in dry pendent sprinkler heads lessen machining, save money

Some 16 years ago the Viking Corporation, Hastings, Michigan, decided to find a way to put sprinkler piping for dry pipe systems above the finished ceiling, leaving only the sprinkler heads visible. This meant designing a sprinkler head which would be free of water except when in use. Thus there would be no drainage problem, and no chance of freezing. The dry pendent sprinkler head as finally developed extends into the sprinkler pipe, where a bronze cap keeps the entire valve waterless. When a fire occurs the usual fusible element melts, two struts drop, releasing the cap and permitting water to flow.

In the original experimental work, the two struts were machined out of solid brass bar. This took time and involved the generation of a considerable amount of scrap, since each strut has four deep fins. Once the idea had proved itself, Viking came to Revere for extruded shapes, in order to save both machining and metal. So much time has elapsed since the original machining of the bar that comparative cost figures would be meaningless, but it is evident to Viking, and to everybody familiar with extruded shapes, that the saving is substantial.

Cross section of Viking Dry Pendent Sprinkler Head, and cutaway view





Outline of the two shapes supplied by Revere

"The Revere Four-Way Service" is a 16mm. sound motion picture in color, educational and informative. If you haven't seen it, write nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

FOR SCUFF-RESISTANT BEAUTY. This Sunroc water cooler has, as standard equipment, a Stainless Steel kick plate for protection against scuffing and corrosion when floors are mopped. The deep drawn top is also made from Stainless. It's bright and inviting, and easy to clean.

FOR LONG, HARD SERVICE. Some of the Stainless Steel tubes in this bundle are 20 years old, despite the fact that they have been in continual service in a thermal cracking unit at a major southwestern oil refinery. Even though some of them have been lengthened by heliarc welding, they still retain their ability to handle corrosive products.

NOTHING *can equal* *Stainless Steel*

FOR SANITATION. This is a Stainless Steel rotary washer at a baby food plant of Gerber Products Company. Stainless Steel was used because of its great corrosion resistance, because it will not contaminate the food products, because it is so very easy to clean. Gerber's uses a lot of Stainless Steel processing equipment—including peelers, bins, steamers, holding tanks and filling machines.

• No other design material can match Stainless Steel in its *combination* of desirable properties: corrosion resistance, strength and hardness, beauty, cleanability and easy fabrication. When seeking a source of supply, remember that United States Steel offers the widest range of types, finishes and sizes available in the United States.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS
PIPE · TUBES · WIRE · SPECIAL SECTIONS

USS

UNITED STATES STEEL

Another Example of

VICKERS®

HYDRAULICS

in Automation

Ex-Cell-O Precision Cylinder Boring Machines shown below are finish-boring V-8 engine blocks. Like so many other high-production machines, these make generous use of hydraulics.

In addition to the advantages inherent in hydraulic control, Vickers Hydraulics gives you the benefits of a nation-wide company-operated field engineering and service organization to assure correct application and operation with least maintenance. Vickers has the complete line of hydraulic equipment necessary to take undivided system responsibility . . . to eliminate any risk of incompatibility of hydraulic components.

The Vickers Application Engineer near you will be glad to demonstrate the many benefits you can obtain by using Vickers Hydraulics. Write for a copy of Catalog 5002B.

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

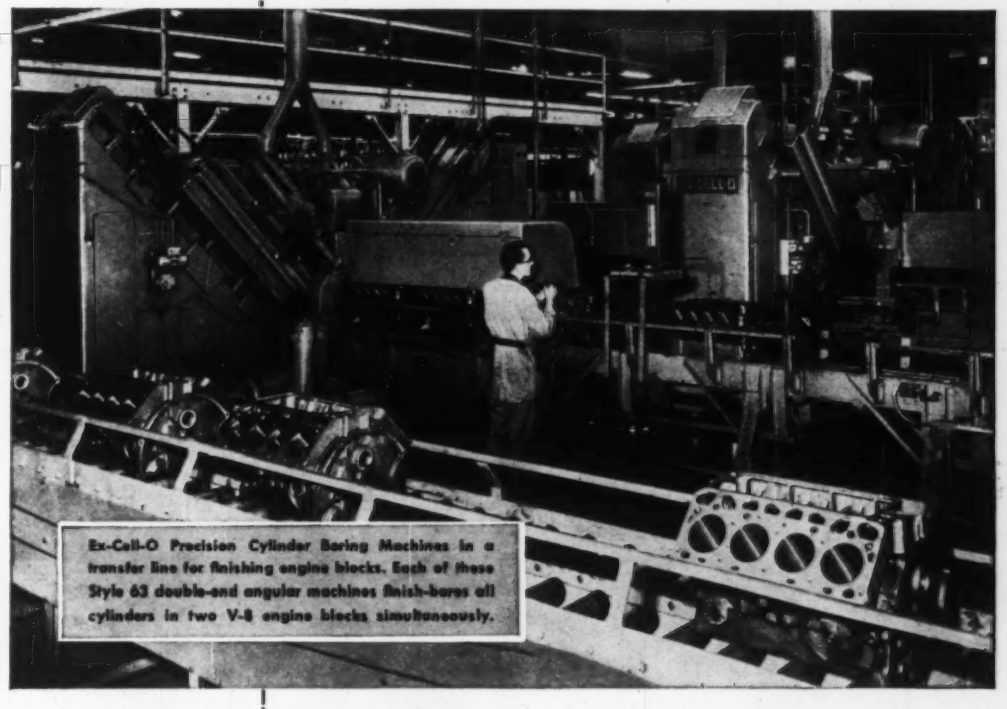
ADMINISTRATIVE and ENGINEERING CENTER

Department 1500 • Detroit 32, Michigan

Application Engineering Offices: **• ATLANTA • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Summit, N.J.) • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS TULSA • WASHINGTON • WORCESTER**

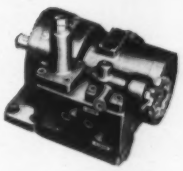
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

Engineers and Builders of Oil Hydraulic Equipment Since 1921



Ex-Cell-O Precision Cylinder Boring Machines in a transfer line for finishing engine blocks. Each of these Style 63 double-end angular machines finish-bores all cylinders in two V-8 engine blocks simultaneously.

Representative VICKERS® Units Used on Ex-Cell-O Precision Cylinder Boring Machines

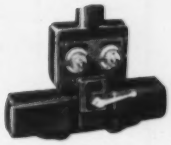


Two-Pressure Pump

Insures lower maintenance cost and saves horsepower and heat in two-pressure hydraulic circuit. Automatically provides high volume at low pressure and low volume at high pressure.

Solenoid Controlled Pilot Operated 4-Way Valve

Compact and versatile "sandwich" construction. Gasket mounting simplifies installation and overhaul . . . also minimizes piping.

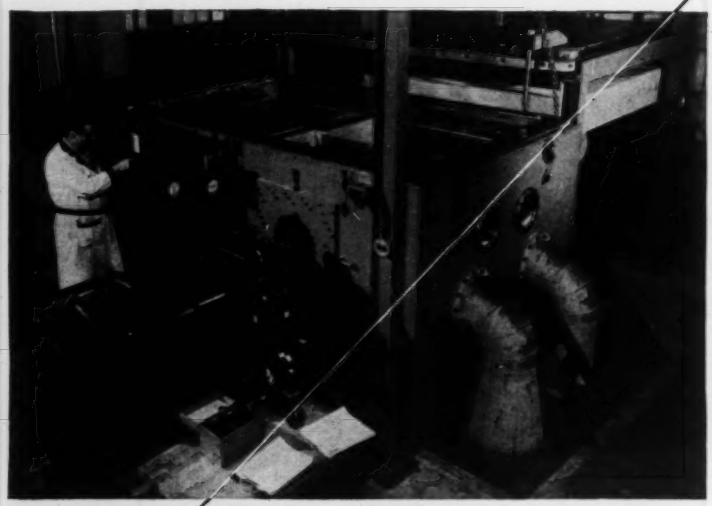


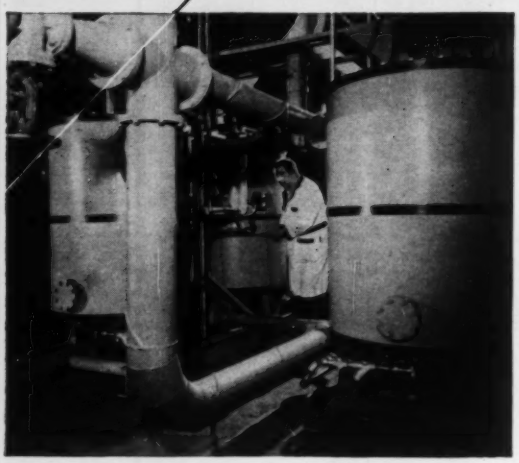
Traverse and Feed Cycle Control Panel

Maintains smooth and constant preset feed rate regardless of fluctuations in cutting tool resistance or hydraulic pressure.

7350

Westinghouse altitude chamber simulates flight 23 miles up





▲ *Test chamber, showing motors for driving equipment on test inside.*

◀ *After the two refrigeration units have dropped the dewpoint to 38°, these two Lectrodryers* take it down to −100° F.*

Since temperatures drop below −80° F., air in this test chamber must be DRY

● Electrical equipment for aircraft, product of Westinghouse Electric Corp. at Lima, Ohio, must meet every possible hazard encountered in flight and on the ground. Their laboratory must be able, therefore, to simulate those conditions —even the 80 degrees below zero found 120,000 feet up.

Air at that altitude is DRY, so this Westinghouse laboratory dehumidifies the air blown through this test chamber to a −100° dewpoint. No chance that frost will form and cloud up test results.

For maximum economy in operation, the air is first "rough dried" by a refrigeration unit to 38° dewpoint. Then two BWC-1500 Lectrodryers remove the remaining vaporous moisture to a −100° dewpoint. Tests can be continued day after day, as these driers can be kept on-stream without interruption.

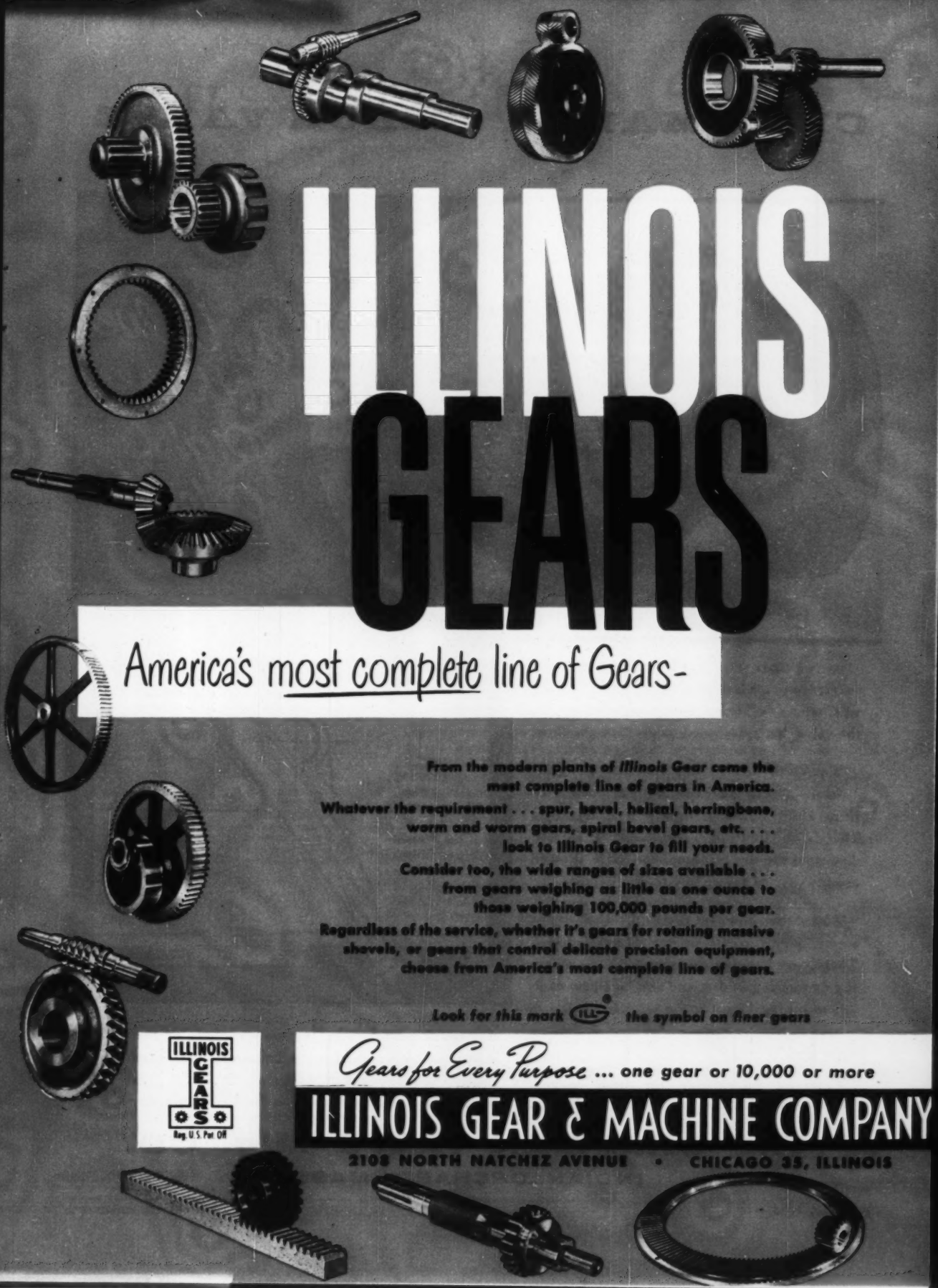
Whether you're DRYing experimentally or on production, there are Lectrodryers to handle the task. For literature on DRYing, write Pittsburgh Lectrodryer Company, 335 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.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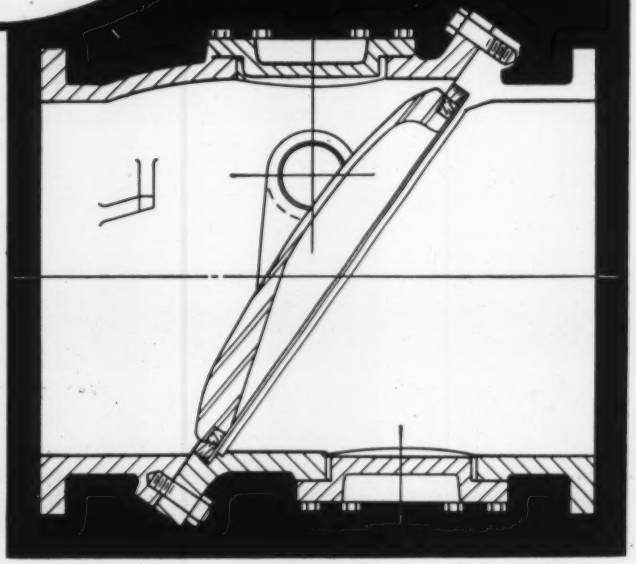
GEARS
America's most complete line of Gears-
From the modern plants of Illinois Gear come the most complete line of gears in America.
Whatever the requirement . . . spur, bevel, helical, herringbone, worm and worm gears, spiral bevel gears, etc. . . . look to Illinois Gear to fill your needs.
Consider too, the wide ranges of sizes available . . . from gears weighing as little as one ounce to those weighing 100,000 pounds per gear.
Regardless of the service, whether it's gears for rotating massive shovels, or gears that control delicate precision equipment, choose from America's most complete line of gears.
Look for this mark ILLG the symbol on finer gears
ILLINOIS GEARS Reg. U.S. Pat. Off.
Gears for Every Purpose ... one gear or 10,000 or more
ILLINOIS GEAR & MACHINE COMPANY
2108 NORTH NATCHEZ AVENUE • CHICAGO 35, ILLINOIS

CHAPMAN TILTING DISC CHECK VALVE

the Valve with the Right Idea!



Here is a cross section of top check valve performance at lowest cost. It's the idea in back of Chapman's Tilting Disc Check Valve . . . the valve that's designed to go with the flow.

When the flow is on, specially designed "airfoil" disc balances perfectly in open position. Fluid holds it tightly against stops. There's no vibration . . . no flutter. It's quiet. And note the design. Ample room is allowed around disc to assure low flow resistance.

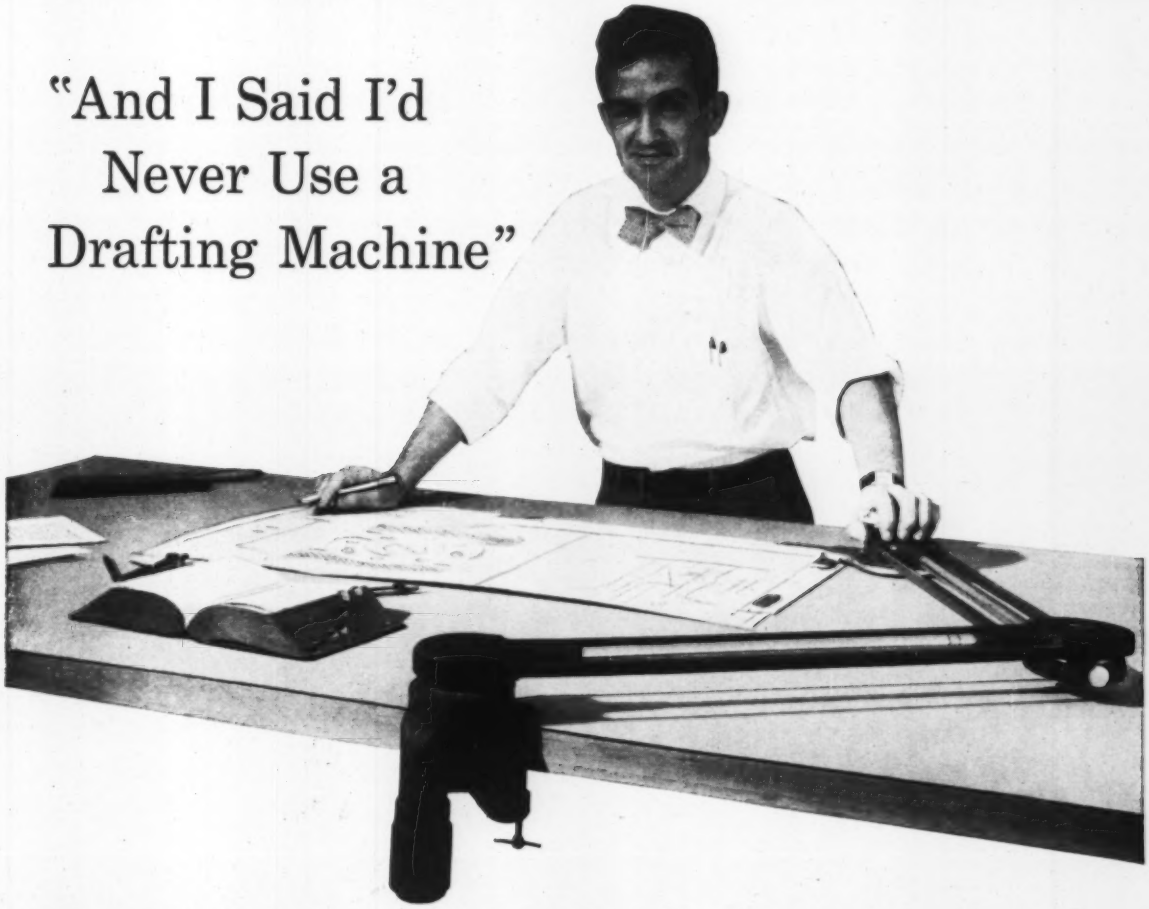
When the flow is reversed, disc drops surely, quietly, *tightly* on special beveled seat. There's no banging, no slamming, no scraping or wearing of disc and seat faces, no damage to piping joints or the valve itself. It's as simple as that. It's as *sound* as that. It has the right idea.

Complete information on these rugged, quiet, long life check valves is highlighted in our Catalog 30-A. Whether you want iron or steel construction . . . whether you handle fluids or gases under a wide range of pressures . . . this catalog gives you all the facts. Send for your up-to-date copy, today.

The CHAPMAN VALVE Mfg. CO.

INDIAN ORCHARD, MASS.

"And I Said I'd Never Use a Drafting Machine"



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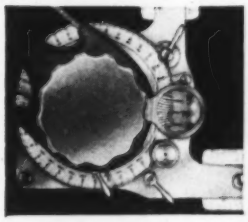
Bruning Counterbalanced Drafters and Bruning Track Drafters provide fast, easy, accurate drafting on vertical boards and on extra-large drawings.



Bruning Equipoise Drafters are available with either the Civil Engineer protractor head, shown here, with its special azimuth scale, or the Standard protractor head.

Take a tip from an increasing number of draftsmen who, perhaps like yourself, were reluctant to try any drafting machine or had been disappointed in a conventional type drafter. These men now report: Bruning Equipoise Drafters cut drafting time over conventional equipment up to 40% on most jobs, up to 50% on some structural drawings — beat any other drafting machine they ever tried.

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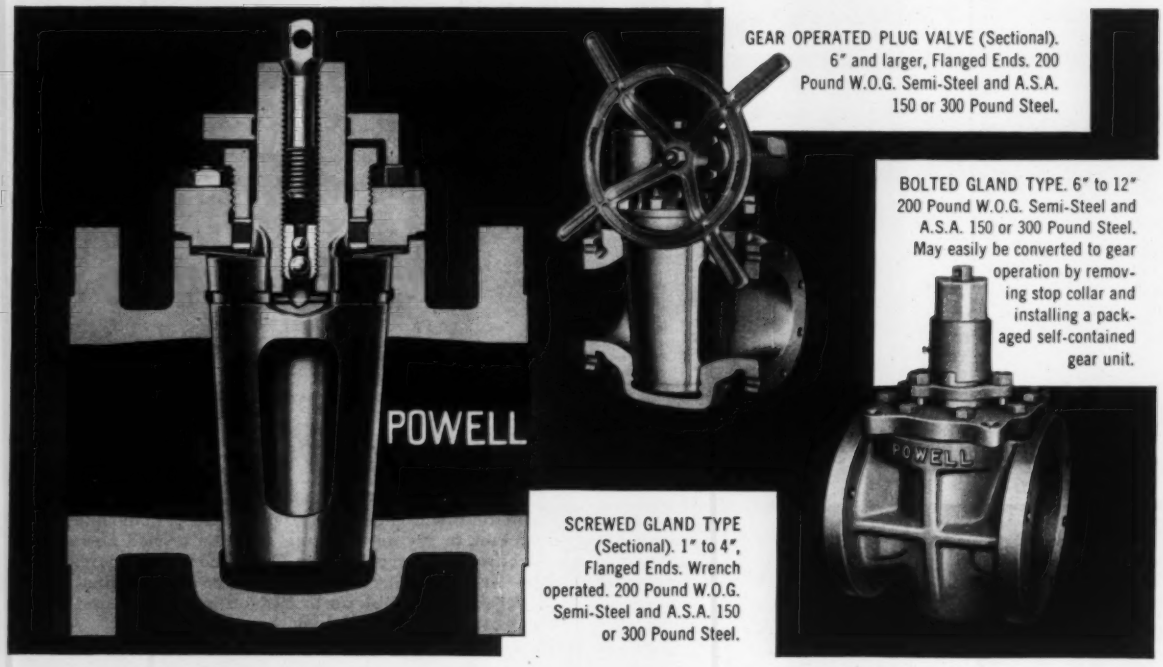

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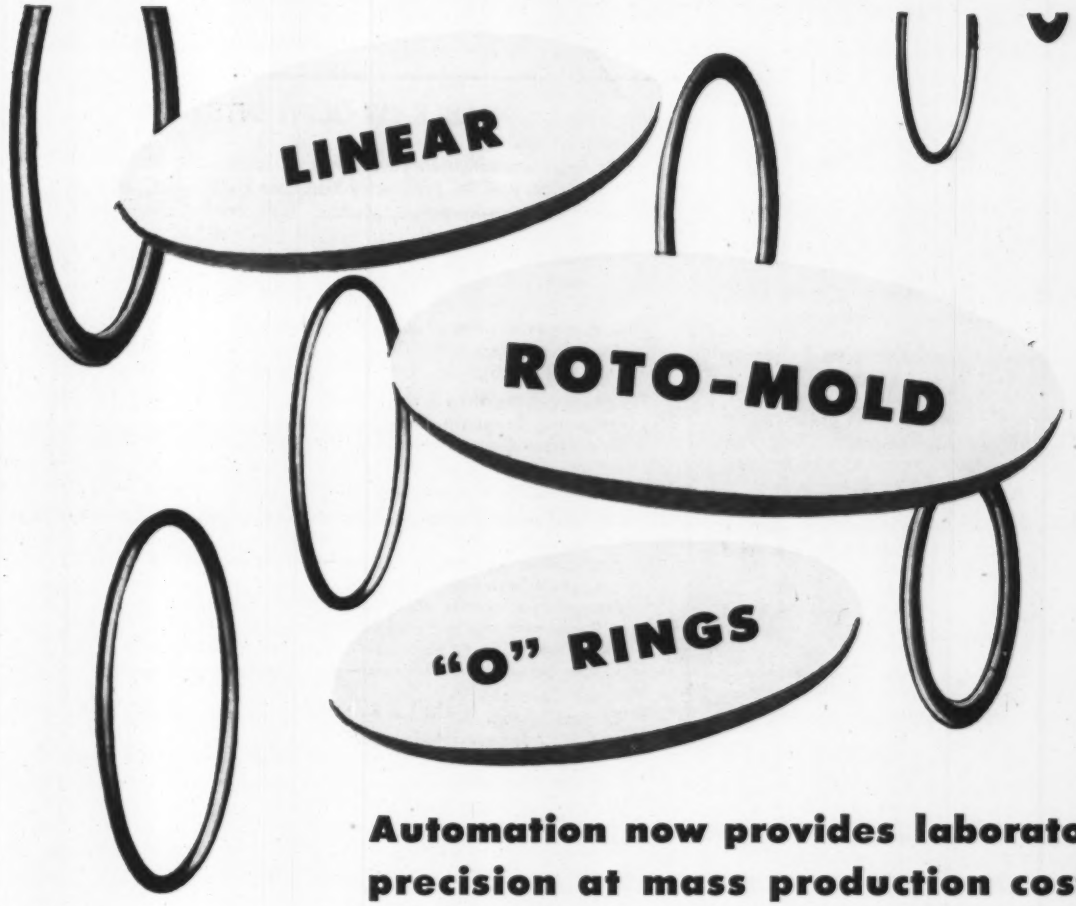

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TABLE OF CONTENTS

Fundamentals
- The Regeneration Theory—H. Nyquist
- Early History of the Frequency-Response Field—A. C. Hall
- *The Frequency-Response Method: A Brief Survey—R. H. Macmillan (England)
- Frequency-Response Data Presentation, Standards and Design Criteria—R. Oldenburger
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- Sine-Wave Generators—D. W. St. Clair, L. W. Erath, and S. L. Gillespie

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- Frequency-Response Method Applied to the Study of Turbine Regulation in the Swedish Power System—V. Oja
- Experimental Flight Methods for Evaluating Frequency-Response Characteristics of Aircraft—G. A. Smith and W. C. Triplett

Process Control
- Control-System Behavior Expressed as a Deviation Ratio—J. M. L. Janssen (Holland)
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- *Frequency-Response Analysis of Continuous Flow Systems—H. Kramers and G. Alberda (Holland)
- *Response and Phase-lag of Thermometers—E. G. J. Eykman and C. J. D. M. Verhagen (Holland)

Transient Response
- Determination of Transient Response From Frequency Response—A. Leonhard (Germany)
- The Use of Zeros and Poles for Frequency Response or Transient Response—W. R. Evans
- *A Method of Estimating Dynamic Characteristics of Physical Systems—S. Lees

Optimum Controls
- A Uniform Approach to the Optimum Adjustment of Control Loops—R. C. Oldenbourg
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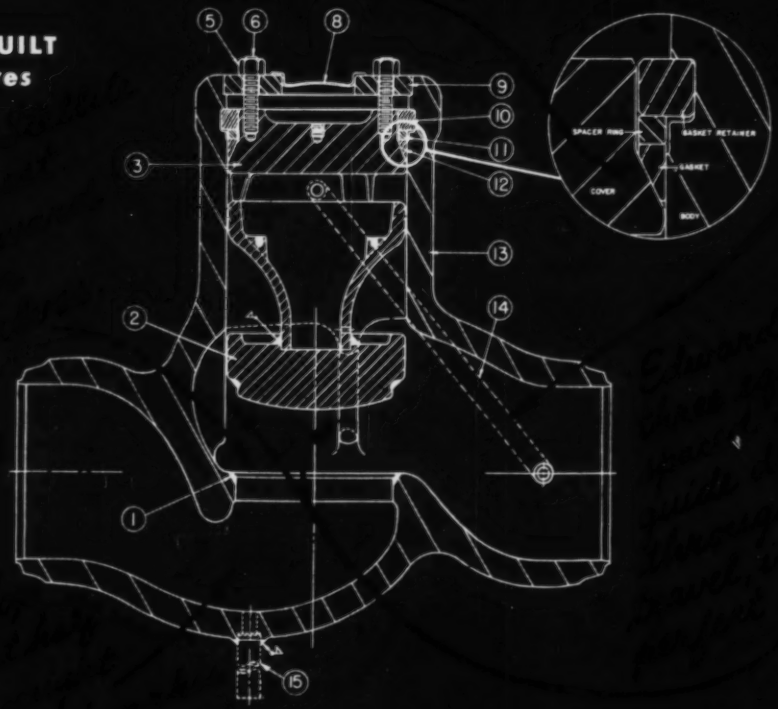

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QUANTITIES ARE FOR ONE VALVE
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PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDWARD MS NO.
1	SEAT	1	INTEGRAL WITH BODY	STELLITED	481
2	DISK	1	FORGED ALLOY STEEL WITH STELLITED SEATING FACE	A.S.T.M A182 GRADE F11 WITH C 0.12% MAX CR 11½% MO ½%	227 481
	PISTON WELDED TO DISK	1	CAST STEEL	A.S.T.M.A 216 GRADE WCB	102
3	PRESSURE SEAL COVER	1	CAST STEEL C-0.25% MAX	A.S.T.M A217 GRADE WC1	209
5	COVER STUD NUTS		STEEL	A.S.T.M A194 GRADE 2H	127
6	COVER RETAINER STUDS		ALLOY STEEL	A.S.T.M A193 GRADE B7	208
8	COVER RETAINER COVER	1	STEEL		
9	COVER RETAINER	1	STEEL PLATE	A.S.T.M A212 GRADE B	115
10	GASKET RETAINER	1	EVALLOY	A.S.T.M A182 GRADE F6	212
11	SPACER RING	1	STEEL		
12	PRESSURE SEAL GASKET		ARMCO IRON-90 BHN MAX.	MALLEABLE PLATED	506
13	BODY	1	CAST STEEL C-0.30% MAX.	A.S.T.M A216 GRADE WCB	102
			CAST STEEL C-0.20% MAX	A.S.T.M A217 GRADE WC6	226
			CAST STEEL C-0.18% MAX	A.S.T.M A217 GRADE WC9	242
14	EQUALIZER *	1	CHROME MOLYBDENUM	SCHEDULE 160 PIPE	229
15	DRAIN NIPPLE	1	CHROME MOLYBDENUM	SCHEDULE 160 PIPE	229

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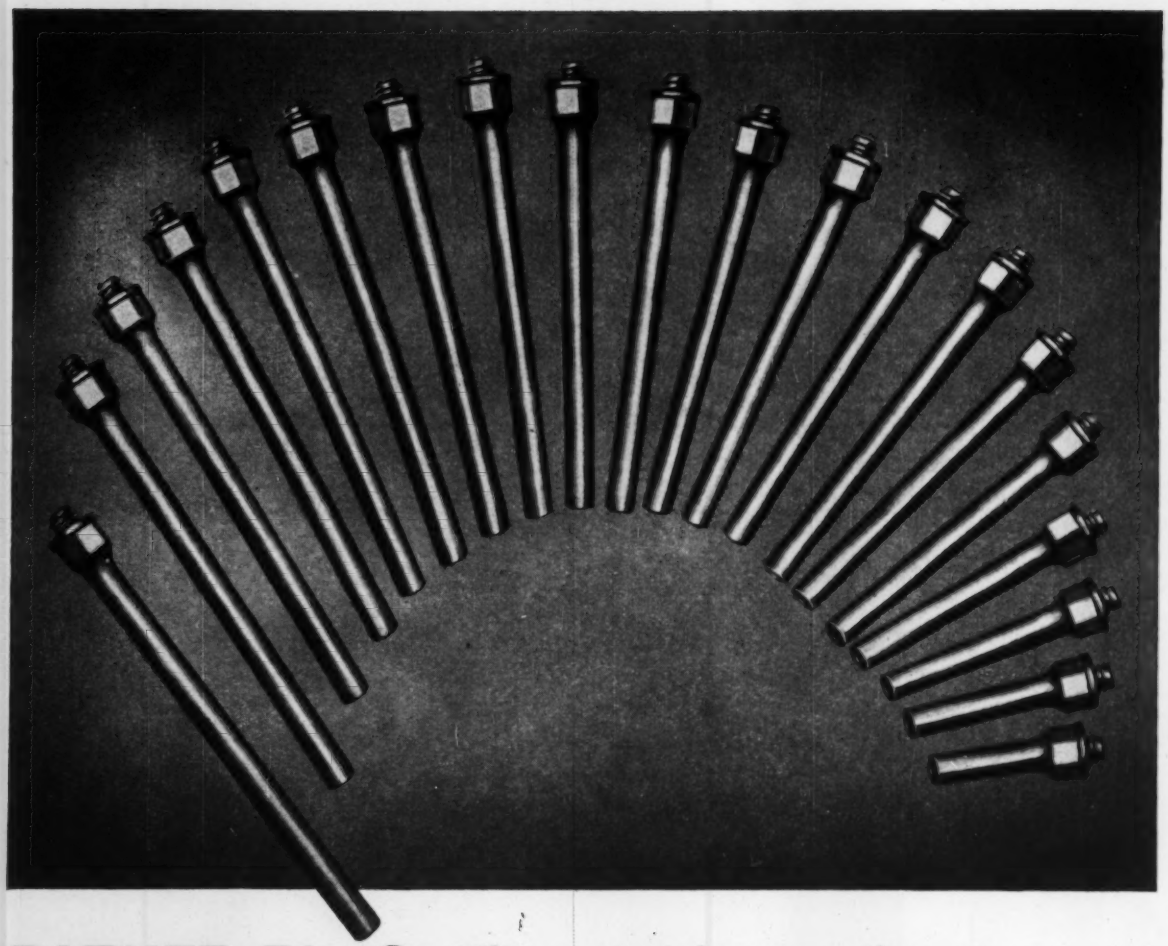

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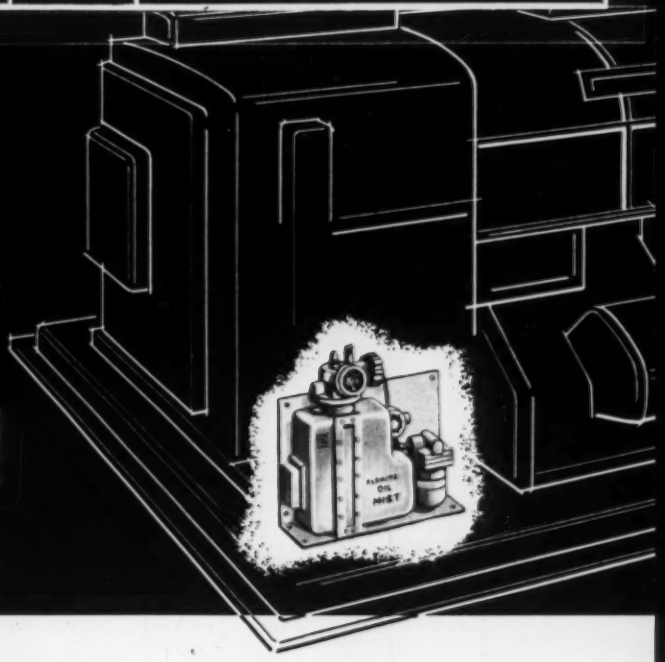

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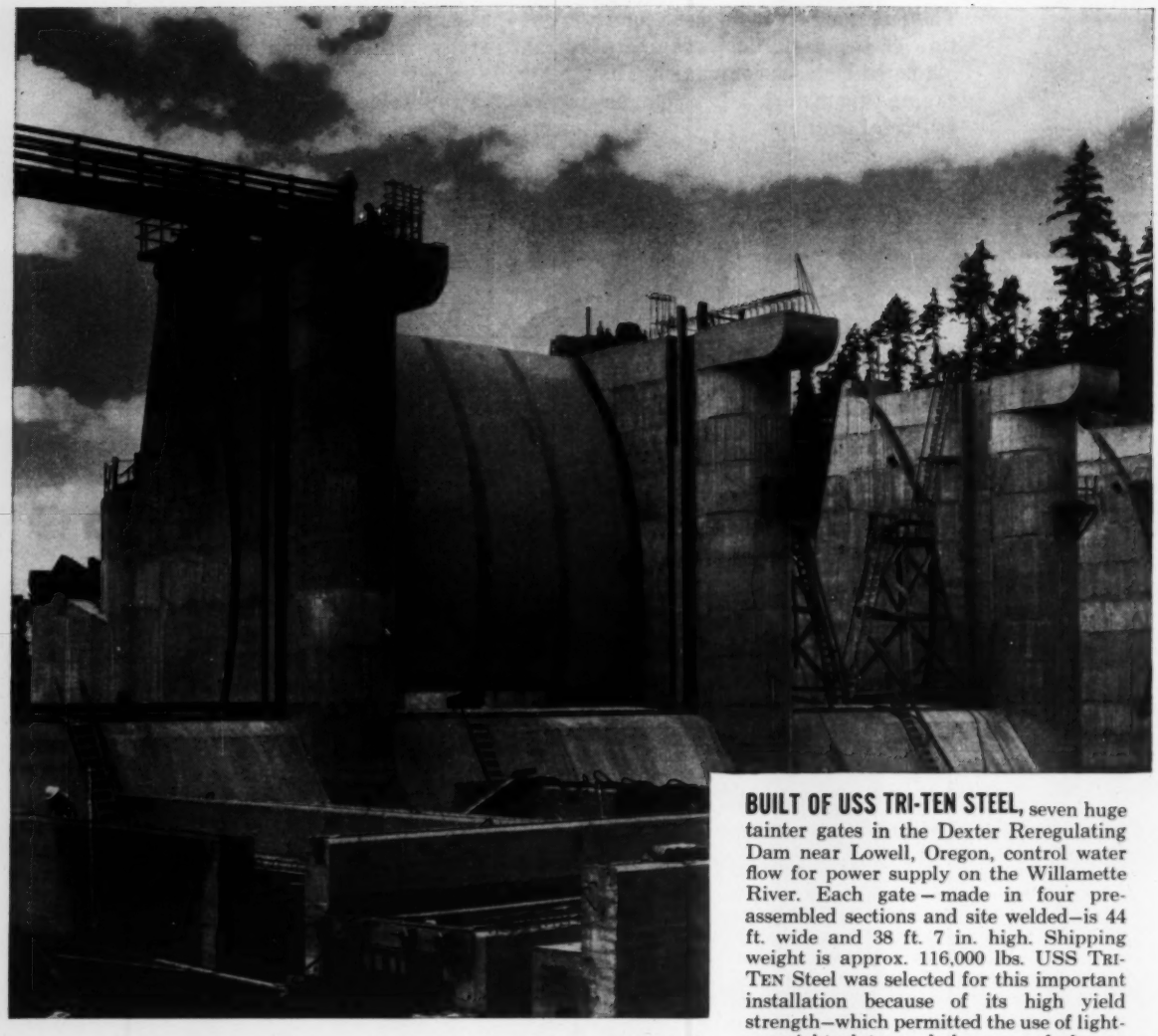
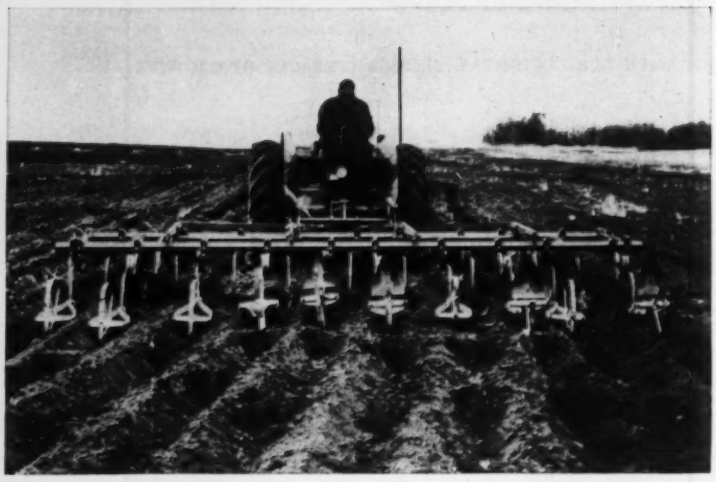


BUILT OF USS TRI-TEN STEEL, seven huge tainter gates in the Dexter Reregulating Dam near Lowell, Oregon, control water flow for power supply on the Willamette River. Each gate – made in four pre-assembled sections and site welded–is 44 ft. wide and 38 ft. 7 in. high. Shipping weight is approx. 116,000 lbs. USS TRI-TEN Steel was selected for this important installation because of its high yield strength–which permitted the use of lighter weight plates and shapes–and also on account of its higher corrosion resistance–equal that of copper steel. (Gates fabricated by Willamette Iron & Steel Co., Portland, Ore., for the Portland District of the Corps of Engineers.)



IN FARM EQUIPMENT, like this Rol-A Dam dammer built by Gunning Manufacturing Co., Lansford, N. D., the use of USS High Strength Steels in vital parts effectively increases life and dependability. Here, USS MAN-TEN Steel in the dammer blades provides superior abrasion resistance plus lightweight and extra strength and toughness. As one manufacturer puts it, "Because farm equipment takes terrific abuse in the field and is generally exposed to the weather without any protection whatsoever, we have found high strength steel construction a 'must'."

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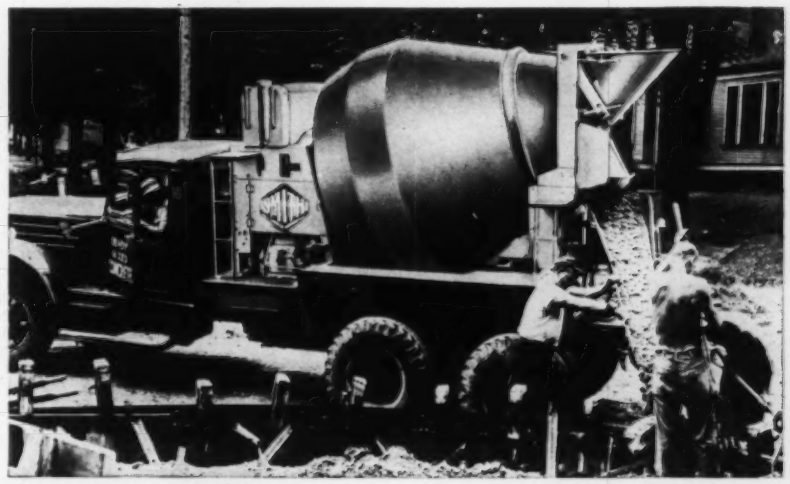
CORROSION RESISTANCE is important in sign poles like this manufactured by C. J. Glasgow Company, Detroit, Mich. Due to the method of construction and design of upright and sign, the inside cannot be kept painted and is subject to corrosive damage. Built with USS COR-TEN Steel, which has 4 to 6 times the resistance to atmospheric corrosion of carbon steel, poles last 2 to 3 times longer. The higher strength of COR-TEN Steel also makes it possible to use steel in lighter gages, saving weight which reduces shipping costs and makes erection easier.



RESISTANCE TO ABRASION, plus the added strength and corrosion resistance supplied by USS MAN-TEN Steel, greatly reduce maintenance and add years of service life to the drum of this highly efficient concrete mixer, built by the T. L. Smith Company, Milwaukee, Wisc. MAN-TEN Steel's ability to resist the grinding action of stone, sand, slag and cement is so generally recognized that the use of MAN-TEN Steel in drums has become almost standard construction by leading manufacturers of truck mixers.

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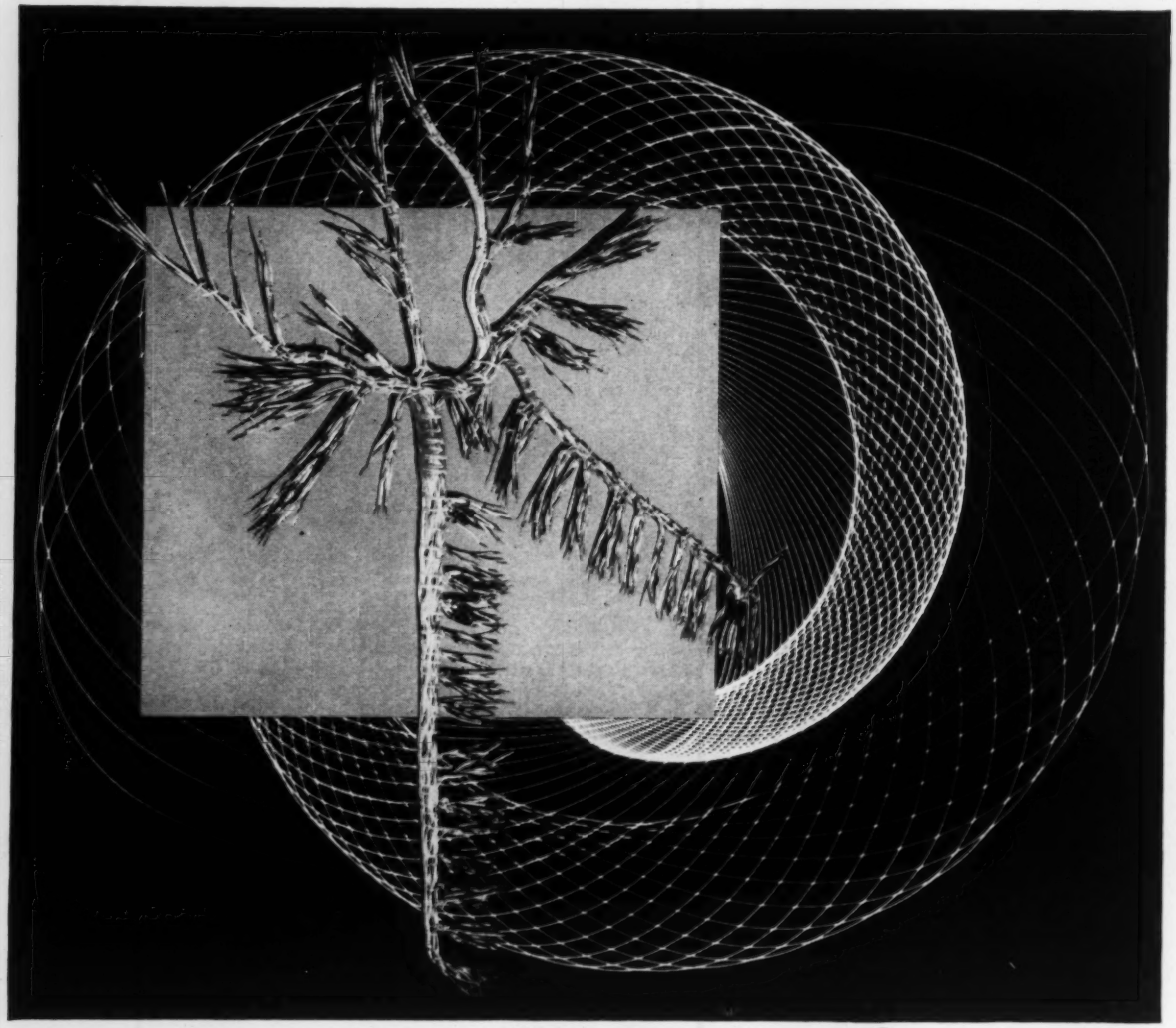

$$\bar{R}\,(T+t) = \bar{R}\,(t) + \dot{\bar{R}}\,(t)T + \ddot{\bar{R}}\,(t)\frac{T^2}{2} + \cdots$$

$$= \tilde{\bar{R}}\,(t) + \int_{-\infty}^{t} \bar{\bar{\omega}}\,(\tau) \cdot \bar{R}\,(t-\tau)\,d\tau$$

The vector equation above is basic to the development of armament controls for high-speed aircraft. A solution to this equation determines predicted target positions. Allied with this solution is the problem of optimum filtering of input data to assure the best overall system performance.

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As a professional, you will be interested to know that AUTONETICS has complete facilities for the research, design, development, flight test and manufacture of integrated fire control weapons systems . . . as well as autopilots, inertial guidance systems, computers and special products. For more detailed information or employment, please write: AUTONETICS, Department ME-N2, 12214 Lakewood Boulevard, Downey, California.

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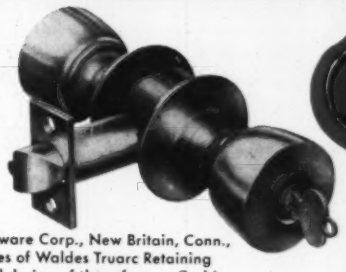
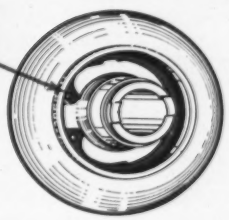
A DIVISION OF NORTH AMERICAN AVIATION, INC

Waldes Truarc Retaining Rings Eliminate Machining— Provide Stronger Assembly, Greater Accuracy



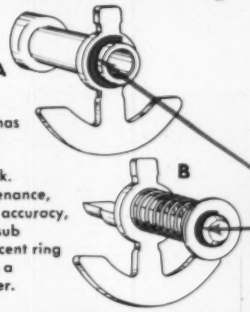
The American Hardware Corp., New Britain, Conn., uses 4 different types of Waldes Truarc Retaining Rings in the original design of these famous Corbin and Russwin Heavy Duty Cylindrical Locks. Truarc rings improve product performance, eliminate rejects, and cut labor costs.

Knob Sub Assembly



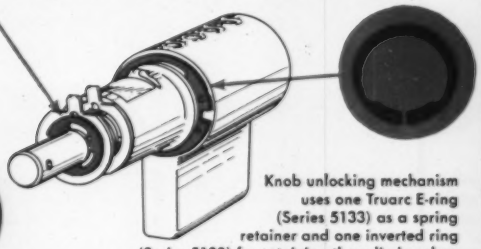
Truarc Beveled Ring (Series 5002) couples the knob to the knob shank. It eliminates two tapped holes and two screws, provides stronger assembly and greater accuracy. Beveled ring takes up end play rigidly.

Spindle Sub Assembly



Spindle sub assembly "A" has two Waldes Truarc crescent rings (Series 5103) used as locating flanges for rollback. This saves labor and maintenance, improves performance and accuracy, eliminates rejects. Spindle sub assembly "B" uses one crescent ring as a spring retainer and as a locating shoulder for washer.

Cylinder Sub Assembly



Knob unlocking mechanism uses one Truarc E-ring (Series 5133) as a spring retainer and one inverted ring (Series 5108) for retaining the cylinder plug. Rings are re-usable in the event of disassembly for maintenance. Rejects are eliminated.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product...to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types...as many as 97 different sizes within a type...5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U.S.A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

For precision internal grooving and undercutting...Waldes Truarc Grooving Tool!

Send for new catalog supplement

WALDES TRUARC® RETAINING RINGS

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send the new supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.
(Please print)

*Name*_____
*Title*_____
*Company*_____
*Business Address*_____
*City*_____ *Zone*____ *State*_____

ME 058

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

WANTED! ENGINEERS TO HELP MAKE LONG RANGE MISSILE HISTORY

North American's Missile Projects Offer A New Engineering Adventure

With complete weapons system responsibility for the SM-64 NAVAHO Intercontinental Guided Missile, North American is engaged in one of the most challenging programs yet offered. But every inch of progress is a tough scientific battle. New means are daily being found to solve the complex problems which the development of long range missiles presents in the fields of structures, temperatures and aerodynamics. But most important of all, *men* must be found who thrive on this kind of challenge . . . men who are really excited about this new missile science. Are you one of them?

If you qualify in one of the fields we have listed below, chances are you can qualify for this unique expedition into the technology of the future. We would like to tell you about all the physical and professional advantages of a career in North American's Missile Development Engineering.

Please contact us for the full story:

Instrumentation Design, Development & Application **Standards, Drawings Checking, Specifications Writing**
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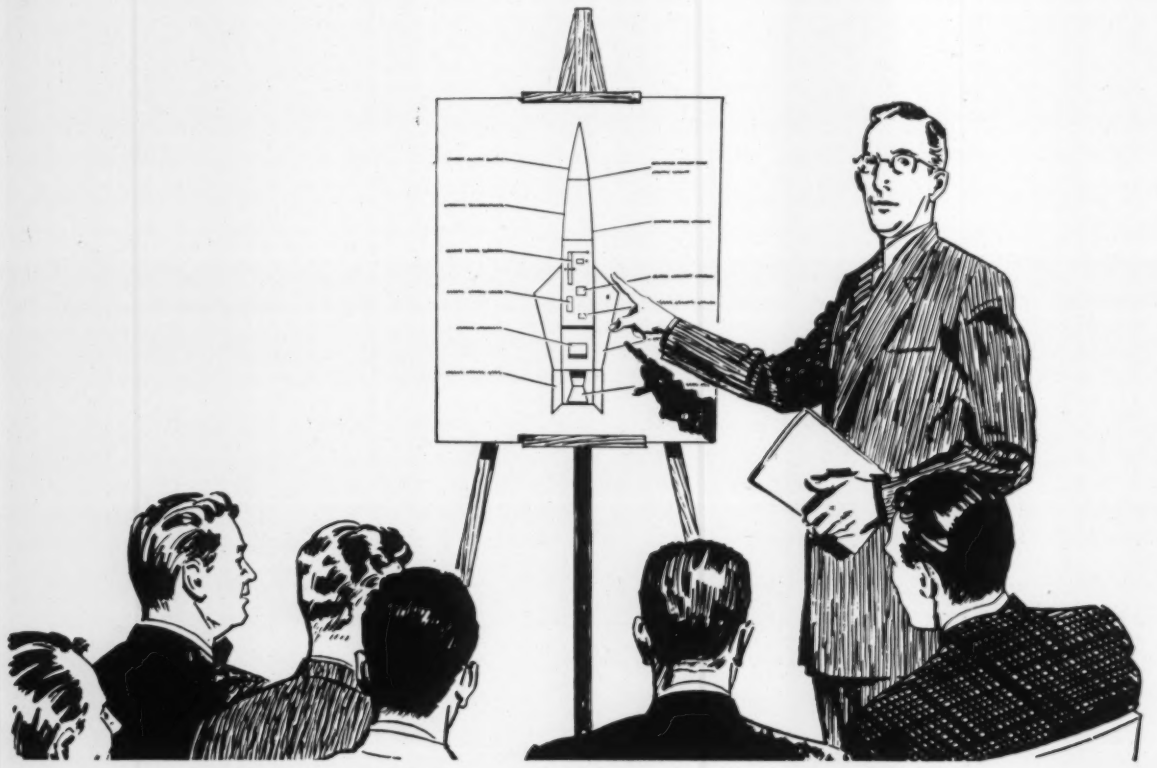
Aerodynamics **Engineering Flight Test** **High Temperature Materials Engineering** **Mechanical & Electrical Design**

Contact: R. L. Cunningham, Missile Engineering Personnel Office
Dept. 91-20ME, 12214 Lakewood Boulevard, Downey, Calif.
Phone: LOgan 5-8651 Ext. 518
Interviews 8 A.M to 9 P.M. Monday through Friday

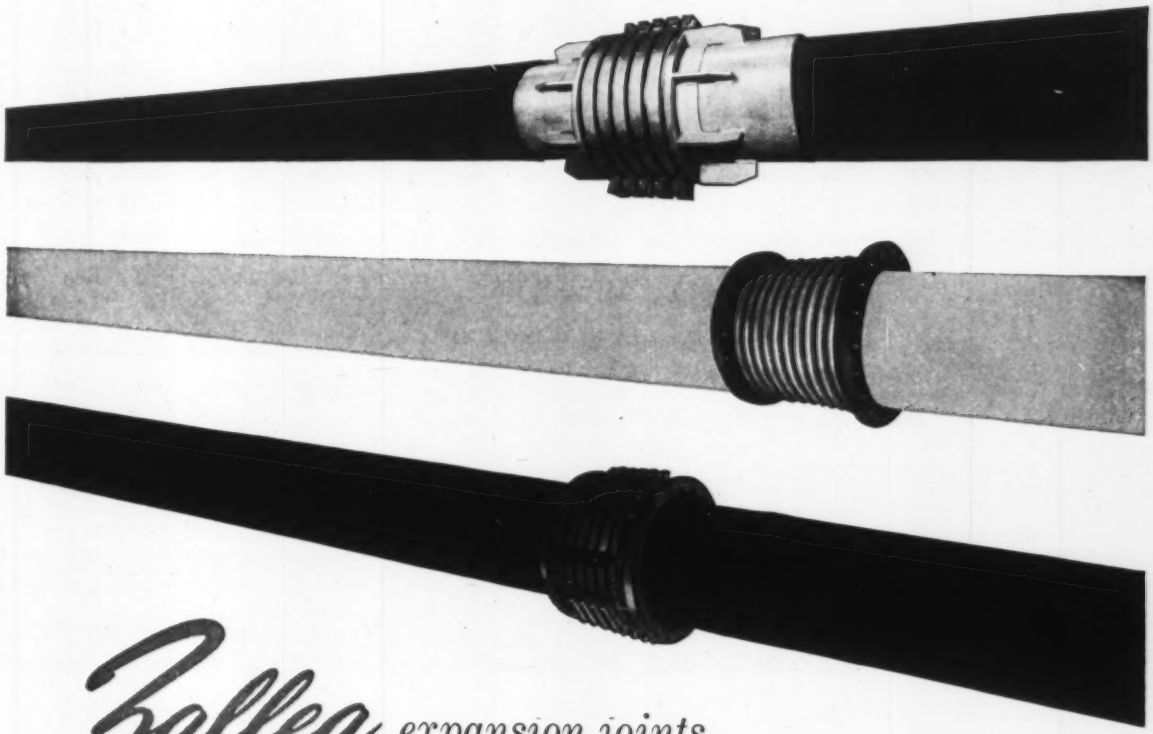
NORTH AMERICAN AVIATION, INC.



The true cost of an expansion joint is not the figure on the manufacturer's price tag. Many factors enter into any such cost determination. For example, an expansion joint that fails just when it shouldn't could wreck a plant and cost a small fortune. And, assuming equal first-cost of any two competitive manufacturers' designs, one that stands up twice as long as the other . . . costs only half as much on a unit-time basis. So, one really shouldn't count on "price" as a measure of value.

But here is one thing you can count on. Every single expansion joint in the Zallea line is designed and built to assure maximum reliability —and top value for your dollar. This is no empty boast, but a fact that can be confirmed for you by figures.

So, whenever you have problems—or needs—relating to expansion joints, don't fail to get in touch with Zallea. Write today for Bulletin 351, containing condensed descriptions of the many types. There is a Zallea joint for every requirement.



Zallea expansion joints

ZALLEA BROTHERS, 820 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

what helps an engineer grow?

"Technical support" says Dr. J. P. Silvers, specializing in thermodynamics, hydrodynamics in reactor design; formerly with Naval Reactor Division of Argonne National Laboratories; now with Avco Advanced Development Division. His answer reflects both the thinking and opportunity in this new Avco division devoted entirely to advanced research and development.

"An engineer should be given plentiful technical assistance. His potential cannot be fully realized when his creative energies are consumed by routine duties."

Helping talented engineers and scientists reach full effectiveness is the best way we, at Avco Advanced Development, know of helping our own growth. For outstanding men, Avco's long-range expansion—in missiles and in all the physical sciences—offers unprecedented opportunity. Write: Dr. E. R. Piore, Vice-President in Charge of Research, Room 412, Avco Advanced Development Division, Stratford, Conn., or Phone Bridgeport, Conn., DRexel 8-0431.

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Advanced degree preferred in—Physics · Aerodynamics · Electronics · Metallurgy · Physical Chemistry · Mathematics · Thermodynamics

Engineers
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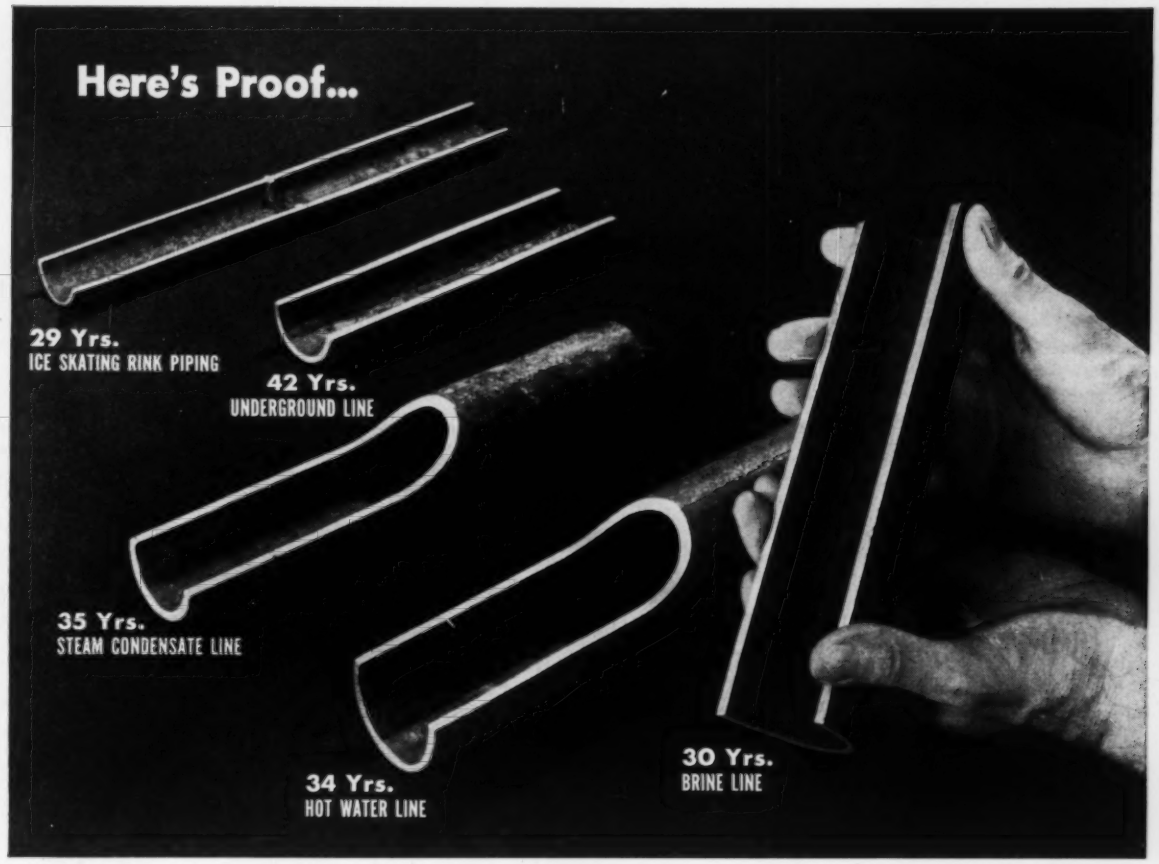
avco
Advanced Development Division

avco defense and industrial products combine the scientific skills, and production facilities of 3 great divisions of Avco Manufacturing Corp.: Avco Advanced Development; Crosley; Lycoming—which currently produce power plants, electronics, airframe components, and precision parts.



WROUGHT IRON PIPE Saves because it Serves longer

True, there's no set rule for predicting how long a pipe material will last in any corrosive service. But there are a lot of mighty dependable clues. The most practical and dependable of all is *service under actual field conditions.*

How does wrought iron pipe measure up when this service-life yardstick is applied?

The answer is documented in the pipe sections shown above. Here you see *actual* samples taken from wrought iron pipe installations in a variety of services. Some of these sections came from buildings that were being torn down. Some were actually cut from in-use installations by our laboratory staff. These sections are interesting not only from the viewpoint of service life, but also pipe condition.

You'll find the reason for wrought iron pipe's ability to last longer in the material's structure and composition. Tiny fibers of glass-like iron silicate are threaded throughout the body of high-purity iron. These fibers are immune to corrosive attack. When corrosion strikes, these fibers halt and detour the attack, prevent rapid pitting and penetration. When you consider that there are more than 250,000 of these fibers to each cross-sectional square inch of wrought iron, it's easy to understand why this material is more than a match for corrosion.

Our bulletin, *Piping for Permanence*, tells more of this story, and covers a variety of services where wrought iron pipe saves because it serves longer. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

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Destinations Unlimited...

Northrop Aircraft, Inc., is a pioneer and world leader in the intercontinental missile field. The recently-disclosed U. S. Air Force Northrop Snark SM-62 is only one of the notable accomplishments in the development of strategic and tactical guided missiles that assure Northrop and its subsidiary, the Radioplane Company, a future of continued leadership in the science of pilotless flight.

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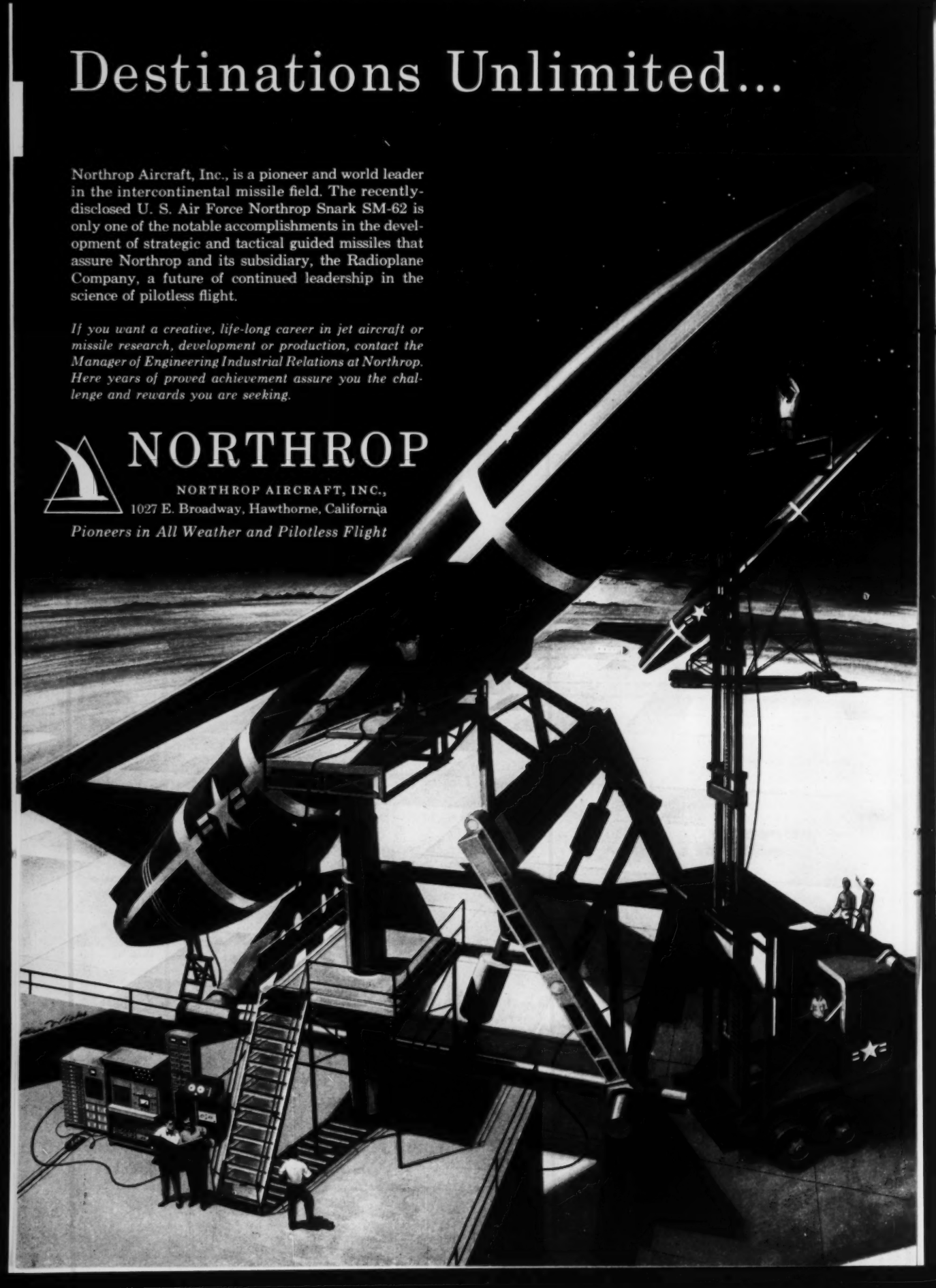
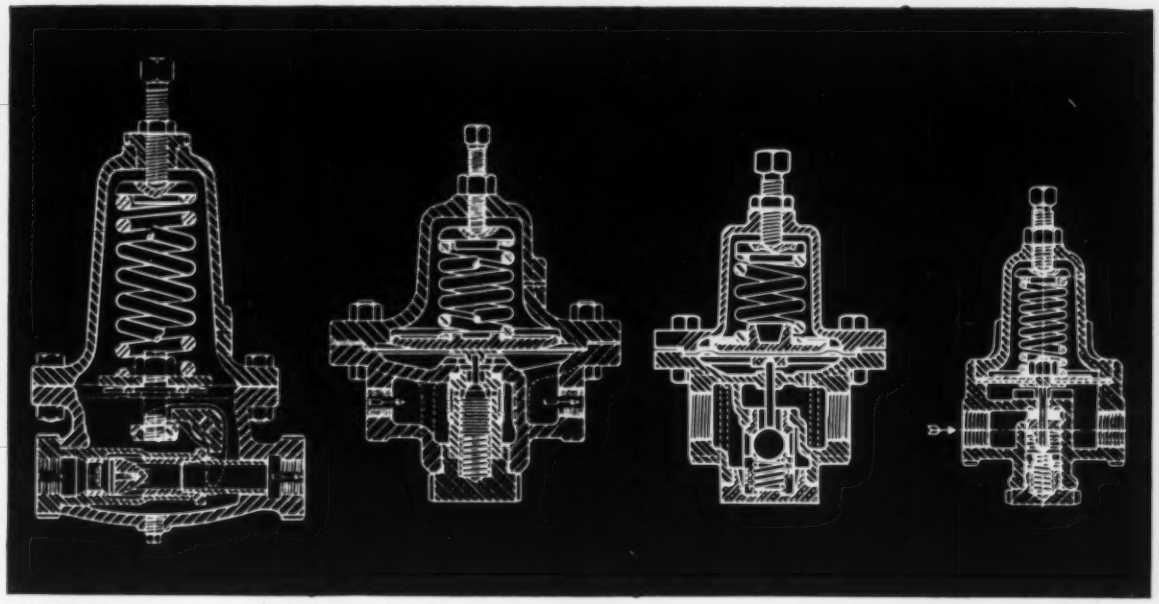
Pioneers in All Weather and Pilotless Flight



What's your pressure problem?

CASH STANDARD

has the answer... *or will find one!*



HERE ARE FOUR TYPES FOR MANY APPLICATIONS

TYPE 1000 — A streamlined, high capacity valve for close pressure regulation — accurate even under toughest working conditions. Closes against the flow, eliminating conditions that cause chatter. Sizes: ¼" to 2", screwed ends. Bulletin 962.

TYPE D — A general purpose regulator with exceptional regulation characteristics. Now improved to permit easier servicing but basically the same dependable valve offered for over 35 years. Sizes: ¼" to 2". Bulletin 950.

TYPE 1260 — A high capacity pressure regulator, small and well proportioned. Available with spherical, self-cleaning inner valve. Suitable for air, water, steam, oil and most fluids and gases. Sizes: ½", ¾", 1", screwed ends. Bulletin S-700.

TYPE 3381 — A small, compact, all-bronze pressure regulator, very accurate and dependable. Available with pressure gauge mounted in one of the two outlet connections. For small lines. Sizes: ¼" and ⅜", screwed ends. Bulletin 948.

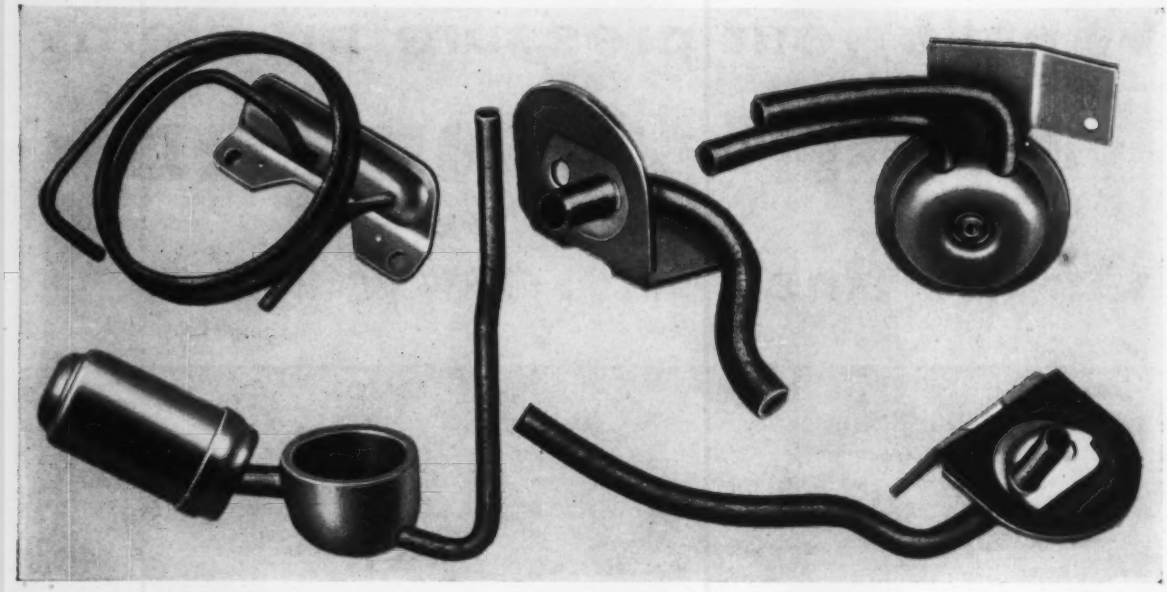
There's a Cash Standard regulator for every pressure control problem!

For an individual solution to your control problem, contact the Cash Standard control specialist in your area, or write Dept. C.

CASH CS **STANDARD**

A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

Pressure, Hydraulic, Temperature, Process and Combustion Controls



Here is a small sampling of the variety of tubing parts produced for Bundy customers. Many of them involved close cooperation between Bundy engineers and the customers, in solving problems of design and function. Are your tubing designs simple or complex? Do they call for serpentine coils, swaging, flattening, expanding, brazing, saddle jointing, bending to small radii, piercing, upsetting, slotting, threading, angle cutting, notching, flanging, flaring, reducing, tapering, other fabrication operations, or combinations of the above? Come to Bundy for the industry's most reliable tubing, most helpful engineering talents, and most versatile fabrication facilities.

Bundyweld Tubing can be fabricated to virtually any design you can dream up

There's no tubing problem big enough to be a design bottleneck when you work with Bundy

Most designers know that Bundy is the leader in small-diameter steel tubing. Many know that Bundyweld Tubing is double-walled from a single strip, to give it unusual properties found in no other type of tubing.

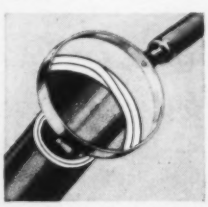
But what we want designers to know, above all, is that Bundy can be of tremendous help at the design stage of any product which utilizes tubing. We offer this help.

Take advantage of this unbeatable combination: expert, free engineering service plus genuine Bundyweld Tubing, double-walled but stronger; high thermal conductivity; high bursting strength; takes easily to any fabrication.

Bundy can help you with that tubing problem. Call, write, or wire today!

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN

Bundyweld starts as a single strip of copper-coated steel. Then it's . . . continuously rolled twice around laterally into a tube of uniform thickness and passed through a furnace. Copper coating fuses with steel. Result . . . Bundyweld, double-walled and brazed through 360° of wall contact.



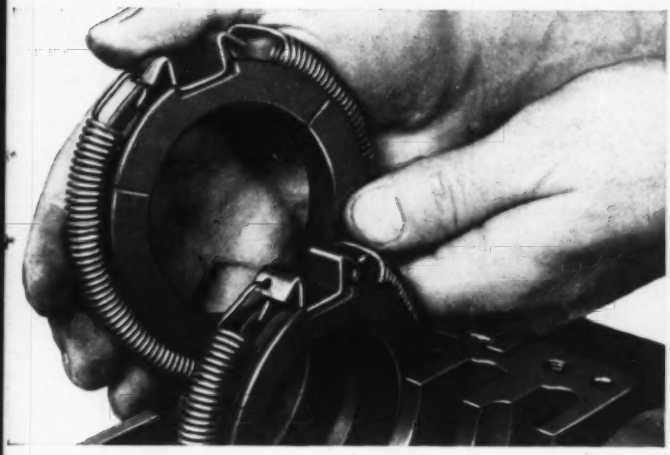
NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

On all General Electric High-speed Turbines,

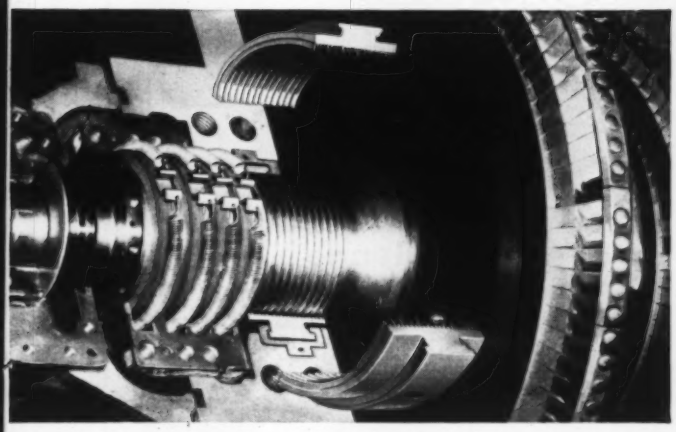
Well-designed, efficient seals...



Low-cost, easily-replaced carbon packings

For the most efficient shaft-end sealing, well-designed, low-cost carbon packings are used on G-E High-speed Turbines to seal steam pressures up to 75 psig. Made of non-galling, self-lubricating carbon-graphite, these segmental rings have high mechanical strength in the small sizes used, assuring long life under normal operating conditions. A garter spring in an offset "V" groove holds each ring together and presses it firmly against the side of the chamber, forming a tight seal. This unique arrangement permits the rings to support their own weight and to adjust themselves to the shaft position, thereby reducing wear and increasing the life of the seal. The rings are contained in compact external packing boxes, and can be easily inspected or replaced without breaking the horizontal joint of the wheel casing.

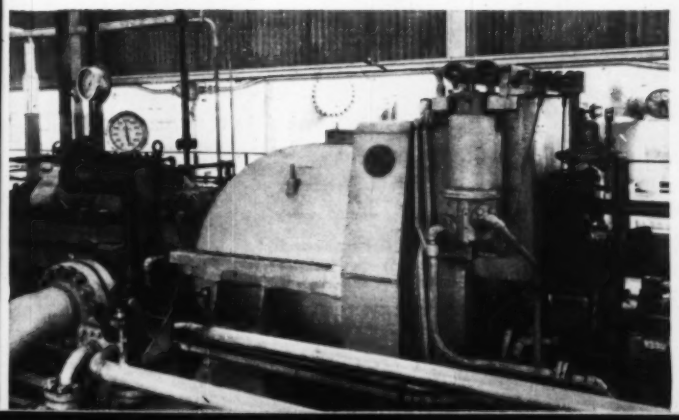
cut steam leakage...



Reliable, long-life metallic-labyrinth seals

To effectively minimize shaft-end steam leakage where shell pressures exceed 75 psig, segmental, high-low tooth metallic-labyrinth seals are used in combination with carbon packing. Between stages, straight-tooth metallic-labyrinth seals are always used. For maximum seal efficiency, minimum clearances between the teeth and the shaft are maintained by precision-machined hook fits in the packing housing. Shaft scoring is practically eliminated since the leaded-bronze segments are spring-backed and can move outward should there be accidental contact with the shaft. When unbalanced steam pressure forces axial movement of the seals, the shoulders of the rings and the housing engage to form a tight steam seal. All labyrinth seals are designed to compensate for thermal expansion, thus assuring a most efficient steam seal at operating temperatures.

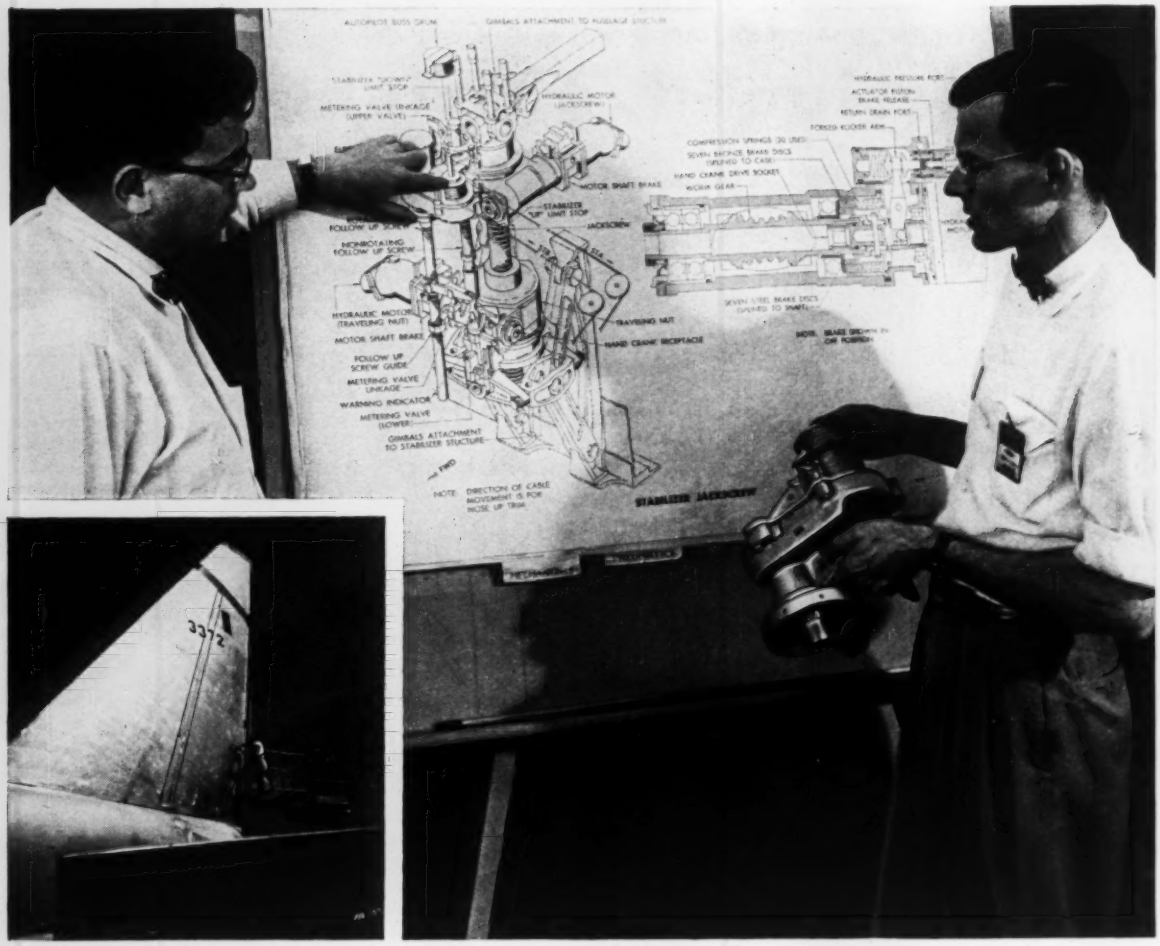
reduce maintenance costs



The careful design and manufacture of these steam seals is your further assurance of low maintenance and consistent reliability of G-E High-speed Turbines. Why not check into the many other sound design features built into these mechanical drives? Your Apparatus Sales Representative will be glad to explain the many benefits they offer to your operation. Contact him for further information or write for Bulletin GEA-6232, General Electric Company, Section 241-7, Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



B-52 jack screw—a typical Boeing design challenge

On Boeing B-52 bombers, the horizontal tail surface has more area than the wing of a standard twin-engine airliner. Yet it can be moved in flight, up or down, to trim the aircraft.

The device that performs this function is a jack screw, which, though it weighs only 255 pounds, can exert a force of approximately 225 *tons!*

Much mechanical engineering skill went into designing and developing a jack screw so precise that it automatically compensates for stretch and compression under load. Mechanical engineers find challenging work on Boeing design projects for the B-52, and for the 707 jet tanker-transport, the BOMARC IM-99 pilotless interceptor, and aircraft of the future. Thanks to draftsmen and engineering aides, Boeing "M.E.'s" are free to do highly creative design work.

Because of Boeing's steady expansion, there is continuing need for additional engineers. There are more than twice as many engineers with the company now as at the peak of World War II. Because Boeing is an "engineers' company," and promotes from within, these men find unusual opportunities for advancement.

Design engineers at Boeing work with other topnotch engineers in close-knit project teams. They obtain broad experience with outstanding men in many fields, and have full scope for creative expression, professional growth and individual recognition. And they find satisfaction in the high engineering integrity that is a Boeing byword.

In addition to design engineering, there are openings on other Boeing teams in research and production. Engineers and their families like the life in the "just-right" size communities of Seattle and Wichita. They may pursue advanced studies with company assistance in tuition and participate in a most liberal retirement plan. There may be a place for *you* at Boeing-Seattle or Boeing-Wichita.

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Boeing Airplane Co., Dept. F-51, Wichita, Kansas
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Boeing Airplane Co., Dept. F-51, Seattle 14, Wash.

If you want further information on the advantages of a career with Boeing, please send coupon to either of the above addresses.

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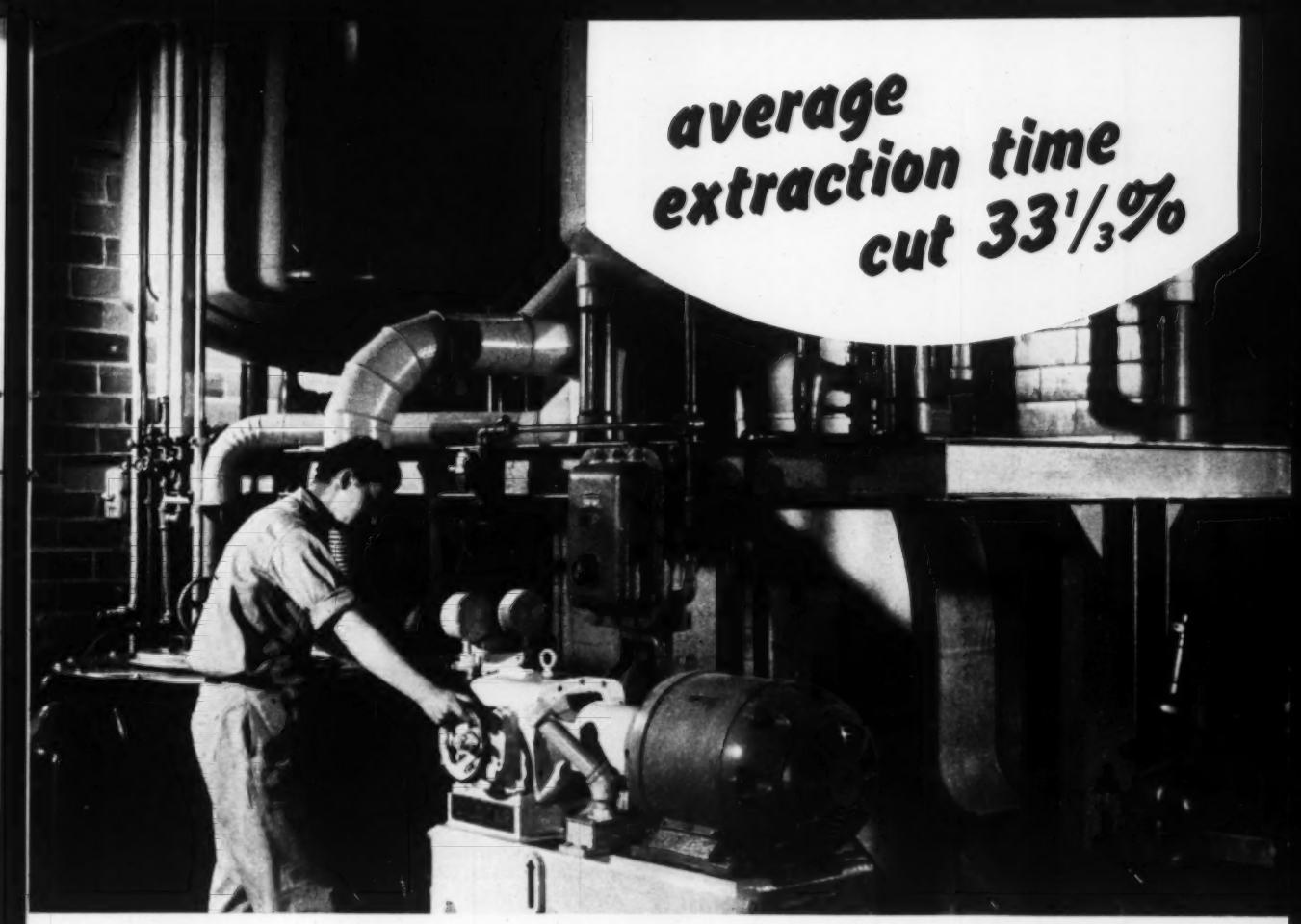

Once more the ANY-SPEED Oilgear Drive betters machine performance "painlessly"

Many times in our experience the performance of an already highly efficient machine has been bettered without redesign, solely by changing the drive. One case out of many *varied* cases, is the Tolhurst Centrifugal pictured above, located in a great pharmaceutical house. This centrifugal was originally equipped with a two speed electric motor drive. However the chemicals it is called upon to handle have widely varying crystal packing characteristics. Some of these crystals packed so densely at the speed available, extraction was inhibited, extraction time far out of balance and crystal removal difficult.

A change was made to an *"ANY-SPEED"* Oilgear Fluid Power Drive. Now the operator is able to shade the speed of the centrifuge experimentally—*and easily discover* the *best* speed for each batch of crystals.

As a result, extracting that used to take from 6 to 9 hours was cut to 4 to 6 hours. The extremely slow speed also available made unloading a great deal easier. This user now has several other Oilgear drives including one on a laboratory centrifuge.

There is very often a direct efficiency coefficient between machine operating speed and the type of work being handled. And we can cite many widely varying instances where equally dramatic and profitable gains resulted at once from a simple change to *"ANY-SPEED"* Oilgear Fluid Power Drives. If you want some interesting factual data on Oilgear's steplessly variable speed drives, their outstanding responsiveness to control impulses, their smooth acceleration and deceleration, talk to an Oilgear Engineering Representative. His mature and sound engineering recommendations may profit you greatly. THE OILGEAR COMPANY, 1570 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

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by Curtiss-Wright gives you better quality high alloy castings, forgings, extrusions

. . . and more of them

A wide variety of high precision metal parts – engineered to the needs of the nation's industries for products that serve you in many ways–are in quantity production today at the Curtiss-Wright Metals Processing Division, Buffalo, N. Y. Here experienced metallurgists work with the latest and most advanced forging and machining techniques . . . centrifugal, sand and ceramic casting equipment . . . the world's largest horizontal steel extrusion press, capable of a 24-million pound "squeeze" . . . and with other improved equipment and methods . . . processing stainless and other steels, titanium, and non-ferrous metals into performance-proven parts . . . faster, more economically.

Offering higher precision, higher production . . . improved techniques with unusual and intricate shapes, to higher specifications . . . products of every description, from jet engine blades to the shredder rings for garbage disposal units . . . Curtiss-Wright Metals Processing has become a prime source for American industry.

If you are a manufacturer, write for facts outlining your specific application today. *Branches coast to coast.*

METALS PROCESSING DIVISION
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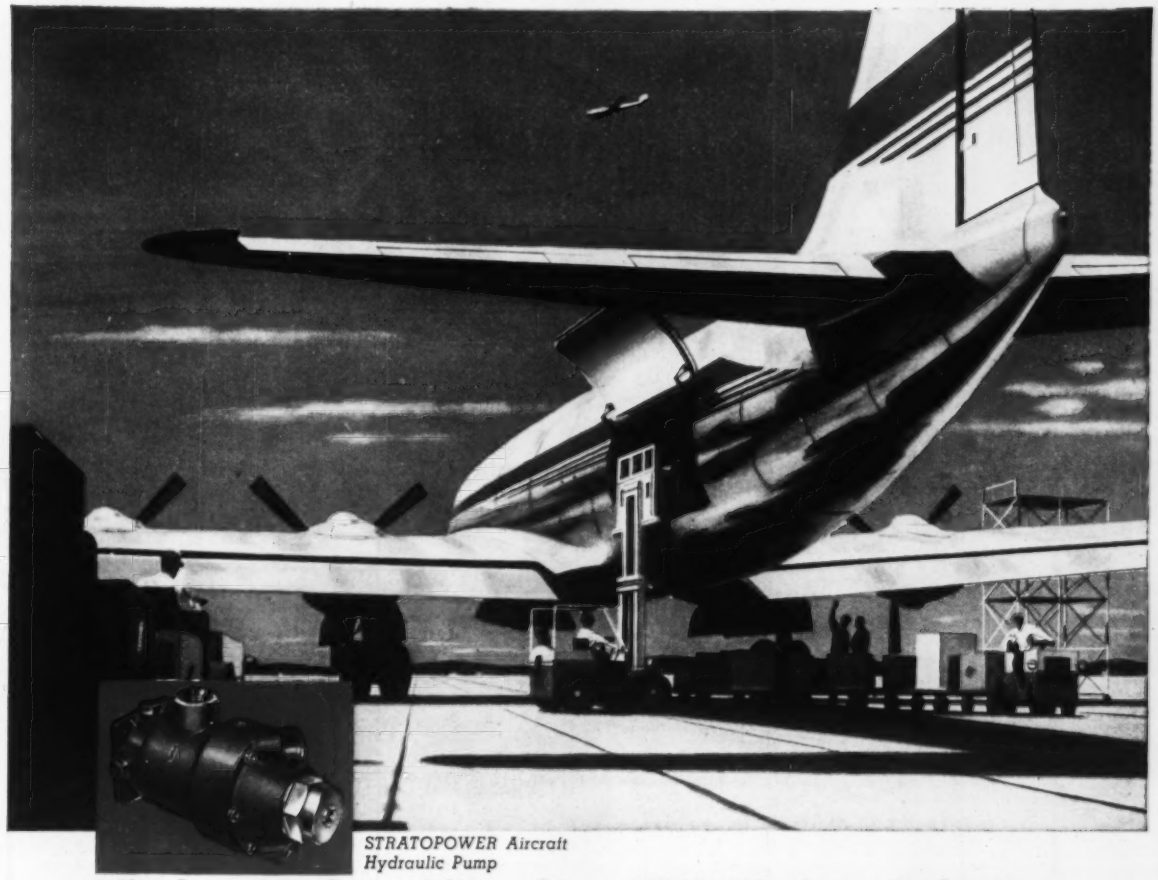
Investigate Career Opportunities At Your Nearest Recruiting Office



STRATOPOWER Aircraft Hydraulic Pump

Vital to Modern Aircraft... AND Modern Industry— FLUID POWER

Forces are so great and response requirements so exacting at today's air speeds that no man is strong enough or quick enough to adjust controls for even the simplest maneuver. Yet, a STRATOPOWER Hydraulic Pump, smaller than a football, provides Fluid Power that enables a pilot, with no more than a "fingertip flip," to perform, precisely and instantly, a dozen jobs. Among these are: raising and lowering landing gear, operating control surfaces or wing flaps. And, STRATOPOWER Pumps with their amazing weight/horsepower ratio perform many other supplementary chores in the air such as: powering air conditioning and pressurizing equipment, radar scanners and other jobs that Fluid Power does better.

More and more, industry looks to Fluid Power to perform functions more rapidly, more perfectly, more economically. Today's Materials Handling equipment is one example wherein HYDRECO Hydraulic Gear Pumps and Motors, Valves and Cylinders have saved untold millions of man hours. DUDCO Dual-Vane Hydraulic Pumps and Motors bring to Machine Tools and Mobile Equipment the advantages of 2000 psi continuous operation. Engineers of The New York Air Brake Company are ready to render assistance wherever a Fluid Power problem exists or may be considered.

In addition to two Divisions specializing in Power Hydraulics, there is valuable "know-how" in Liquid Handling at Aurora Pump and Kinney Mfg. Divisions plus intimate knowledge of Vacuum Processing in the Kinney Mfg. Division.

As Fluid Power plays an increasingly important role on land, sea and in the air, it becomes more important to you to become better acquainted with new developments of The New York Air Brake Company.

KALAMAZOO DIVISION
Kalamazoo, Mich.
HYDRECO Gear-Type Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 3 to 52 hp; Cylinders; Control and Auxiliary Valves; 1500 psi. DUDCO Dual-Vane Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 7 to 140 hp; 2000 psi operation.

WATERTOWN DIVISION
Watertown, N. Y.
Railroad air brake equipment of all types, STRATOPOWER Hydraulic Pumps for Aircraft, to 3000 psi.

AURORA PUMP DIVISION
Aurora, Ill.
Liquid Handling Pumps, Centrifugals and deep well Turbines, 7000 gpm, 500 ft. heads. Turbine-type, 150 gpm, 600 ft. heads. Condensate Return Units.

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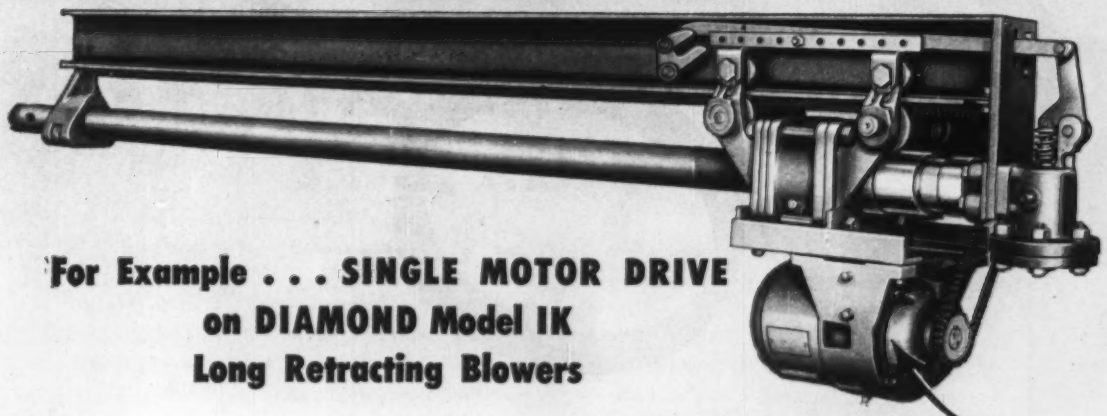
A Diamond Policy for Decades:

"Keep It Basic" "Avoid Unnecessary Complications"



For Example . . . SINGLE MOTOR DRIVE on DIAMOND Model IK Long Retracting Blowers

A Single Motor (air or electric) Both Rotates and Propels the Long Lance Tube

Diamond engineers have always felt that it isn't enough to design a mechanism that will do a particular job. It is also important to make that mechanism as simple and dependable as possible. It has been a Diamond policy for decades to *"keep it basic"* . . . to avoid unnecessary complications that make trouble for users.

Diamond Soot Blowers are simple, effective, dependable. Typical of this is the single motor drive on the Model IK Long Retracting Blower. One motor working through a simple system of rugged gears simultaneously propels the carriage and rotates the lance tube. The ultimate in simplicity and reliability, there is only one set of motor elements, one set of control elements, and one set of power supply facilities to operate and maintain. Long experience with all kinds of cleaning problems has demonstrated conclusively that there is a single universal cleaning pattern suited to substantially all conditions encountered.

Other important features of Model IK are the mechanically operated valve with adjustable pressure control, and the positive gear drive. For additional information ask for Bulletin AA.

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efficient, long-wearing seals produced at reasonable cost with compatible

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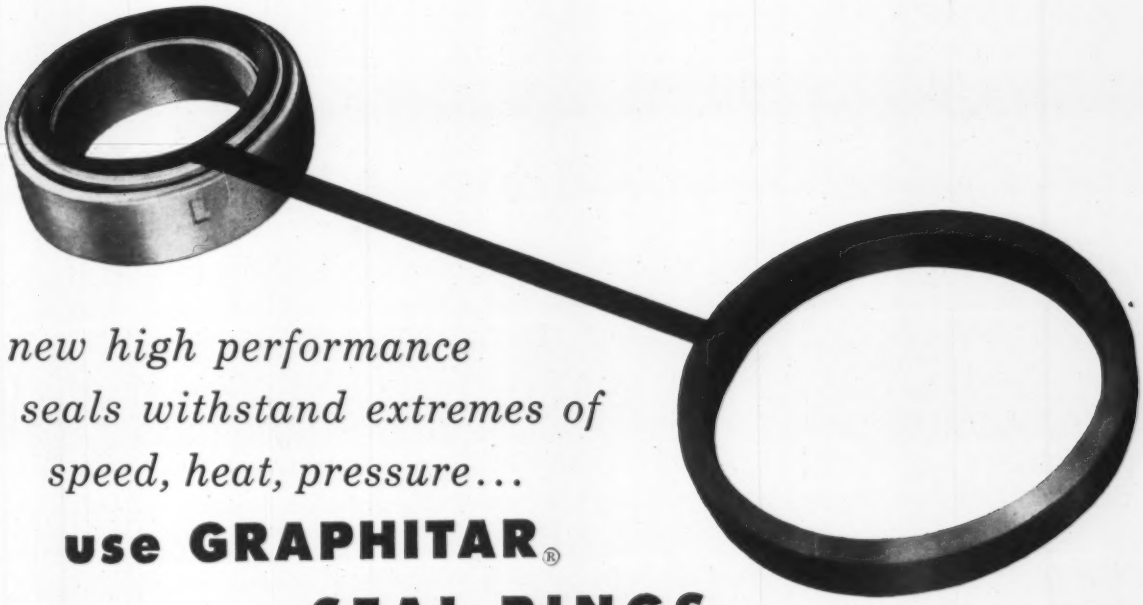
GRAPHITAR is not only a high-quality seal material, but when produced in volume, an economical one as well. In low-pressure applications where mechanical seals have heretofore been too expensive, the Gits Bros. SGU stock shaft seal, using GRAPHITAR wearing and sealing elements, is finding wide use. Cost of the GRAPHITAR seal rings is reasonable enough to make the SGU practical in such high-volume products as washing machines, garbage disposal units, and pumps. Performance is excellent, due to GRAPHITAR'S low friction, high strength, durability, self-lubricating properties and its guaranteed continuing inertness to all known detergents. The long life of the SGU seal is further assured with a GRAMIX Grade 263 nickel-bronze seal-seat. GRAMIX Grade 263 is also corrosion resistant to detergents and the wear and sealing-in characteristics are especially compatible with those of GRAPHITAR. As a result, the Gits SGU shaft seal combines economy with very efficient operation, and is manufactured in standard sizes ¼″ thru 2″ and in shaft increments of ⅛″.

SGU Seal Performance Data:

Speeds.....1750 to 3600 FPM	*Sealed Liquids* Soaps, Greases, Animal Fats, Strong Detergents
Temperatures Continuous.....250°F. Intermittent.....275°F.	*Lubrication* Soaps, Greases, Animal Fats, Strong Detergents and water splash lubrication
Pressures Normal.....10 to 15 psi Maximum.....35 to 40 psi	

THE UNITED STATES



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Temperatures.....400°F. maximum	*Lubrication* Mists, vapors, full fluid
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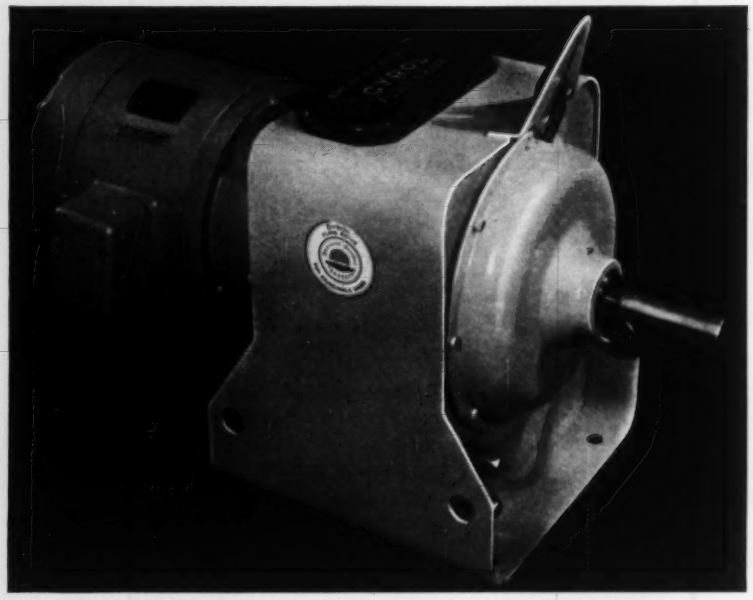

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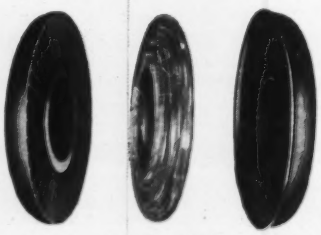

Gýrol Fluid Drive provides a simplicity of design and a flexibility of operation no other method of power transmission offers – plus an inherent safety factor. Operates on hydro-kinetic principle, using vortex of oil to transmit power from driving to driven machinery. Power is transmitted smoothly, evenly, efficiently, without shock.

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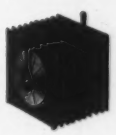

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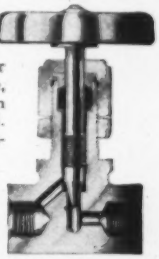

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by BOB SIBLEY
Aviation Columnist

There's an engineer's idea of paradise down in Windsor Locks, Connecticut: it's the fabulous, new Hamilton Standard plant, one of the most modern in the country. This 37-year-old company gained fame years ago with the manufacture of propellers . . . Lindbergh, Byrd, Wilkins and Kingsford-Smith are among the giants of aviation who relied on Hamilton's propellers.

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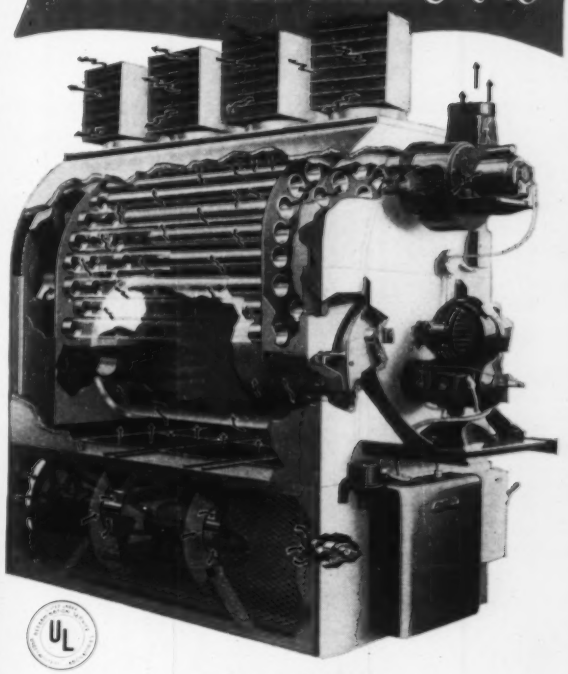

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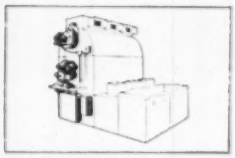

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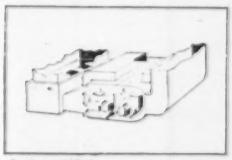

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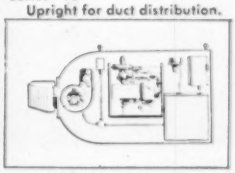

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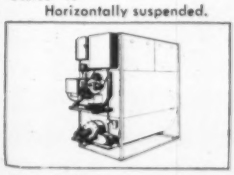

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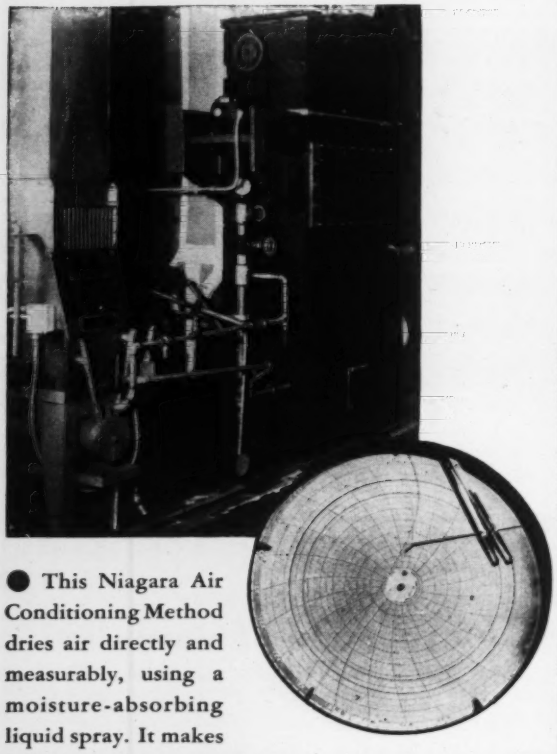

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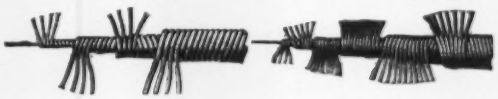

Power drive cable with wires partly unwound to show construction of the cable.

Section of remote control cable showing superimposed layers of wire wound in opposite direction.

The other type of flexible cable is the remote control flexible cable which due to being constructed of smaller gauged wires than the power drive cable, and wound by a special process, provides for both rotation and reciprocation such as the opening and closing of a valve.

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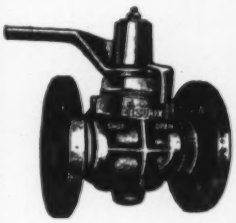

DeZURIK SHOWER CO.

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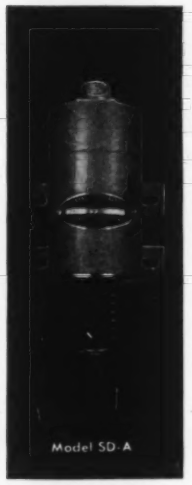

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Specifications—SD Solenoids can be furnished in all standard voltages up to 115 Volts D. C.

10 lb. pull over 1½ inch stroke.

Power consumption, 550 Watts pulling and 8 Watts holding.

Housing dimensions, 4⅝" x 2½".

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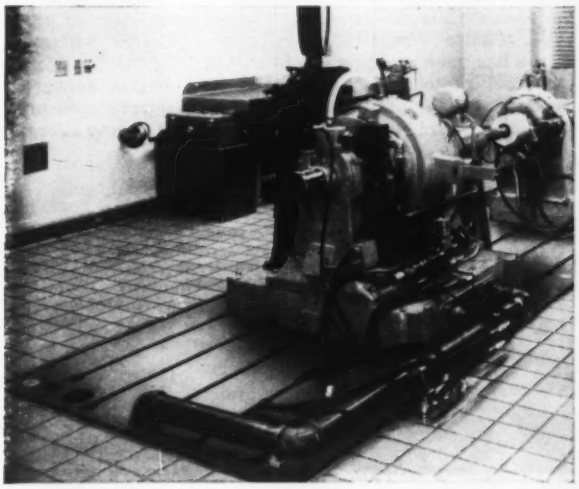

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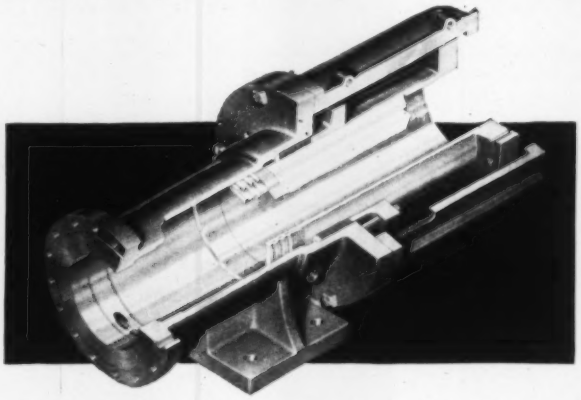
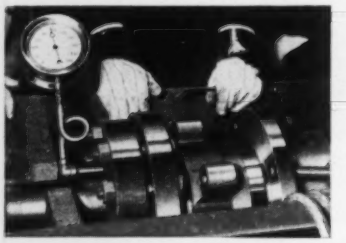


PROOF FROM THE PITTSBURGH TESTING LABORATORY



All packing has been removed. There is no trace of steam in the empty stuffing box, even though steam in the line is at 240 lbs. with 700 F total temperature.

● For simple maintenance, a new ring of packing can be added to an ADSCO Piston-Ring Slip-Type Expansion Joint, but when the old packing has been allowed to become scored, it should be removed and replaced with fresh packing. The ADSCO Piston-Ring Joint is the only joint in the world in which this can be accomplished without shutting off line pressure. With the vent valve open, piston rings hold the line pressure while the joint is being serviced as in photograph at left.

Other features: The slip is continuously guided at its extreme ends throughout its entire length of travel. Primary and secondary limit stops prevent the slip from being pulled out of the body. Openings in the external guide provide easy access to the packing gland for adjustment. The external guide is built in halves to reduce the size of manholes required in underground construction.

These ADSCO Piston-Ring Joints are available in both single and double types, in full range of sizes, with 4", 8", and 12" traverse per slip, and for temperatures to 800 F and higher.

● *Write for Bulletin 56-20.*

AMERICAN DISTRICT STEAM DIVISION
ADSCO INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

POSEY PRESSURE VESSELS

YOUR requirements and specifications may differ from those of the major oil producer who ordered this Posey Pressure Vessel for installation in South America. Posey Iron has been meeting the most exacting specifications in steel plate fabrication for almost half a century. Depend on Posey facilities and know-how your your pressure vessel requirements . . . any size, any metal.

DRUM DIMENSIONS
Diameter 12' Length 36'
Heads 7/8" thick
Shell 11/16" thick
OVERALL DIMENSIONS
Diameter 13' 7"
Length 43' 7"

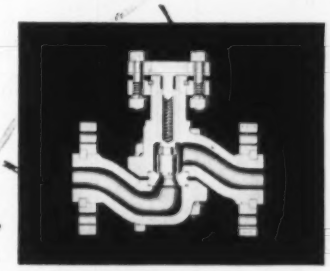
Posey Pressure Vessels are tested to considerable excess over specified working pressures. All meet ASME, API-ASME and API code requirements. Write for complete information without obligation.

TANKS • DIGESTERS
DREDGE PIPE • STACKS
STEEL PLATE FABRICATION

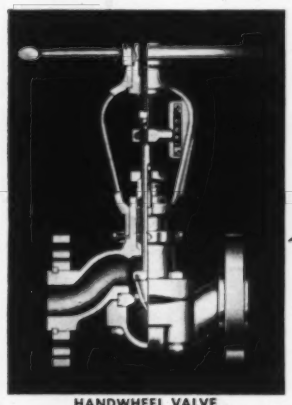
POSEY IRON WORKS, INC.
STEEL PLATE DIVISION LANCASTER, PA.
NEW YORK OFFICE : GRAYBAR BUILDING

AROUND-THE-CLOCK RELIABILITY with Annin

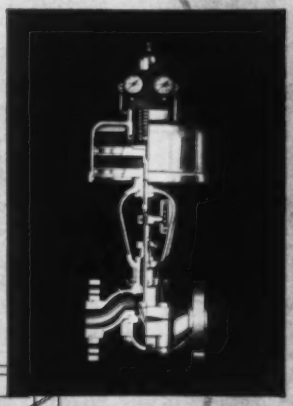
The complete line of Fluid Control Valves to meet every installation requirement



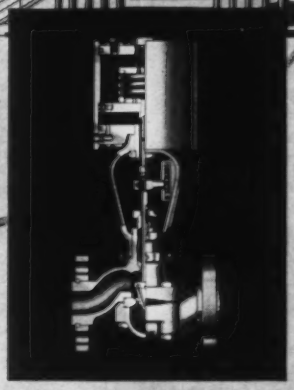
CHECK VALVE



HANDWHEEL VALVE



DOMOTOR VALVE



CYLINDER VALVE

Yes, *Annin* offers design and control engineers a complete line of valves for rugged and reliable performance "around-the-clock." Name the installation—rocket stand, aircraft component test facility, chemical plant, refinery, paper mill or power plant—and *Annin* valves will exceed the most critical performance needs, with features like:

- **Piping flexibility**
- **Pressure ratings to 10,000 PSI**
- **Body designs for gases to molten metals**
- **Temperatures from −400°F to +1600°F**
- **Interchangeable operators—Domotor, Cylinder or Handwheel**

ANNIN'S new and comprehensive valve catalog 1500-C is now ready for distribution. Send for your copy today.

ANNIN

THE ANNIN COMPANY

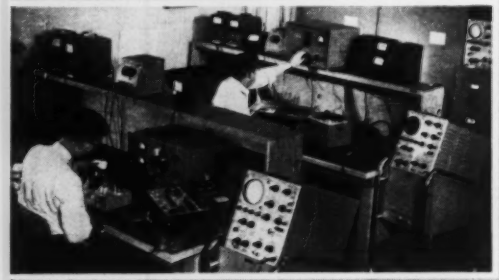
6570 EAST TELEGRAPH ROAD, LOS ANGELES 22, CALIFORNIA

Control VALVES

AIRBORNE ELECTRONICS AND WEAPON CONTROL SYSTEMS

Denver manufacturing plant now under design

Infrared laboratory



Instrumentation laboratory

Initial unit of flight test facility

Communications pilot line production

Simulators in computing center

At Ramo-Wooldridge today there exists a wide range of projects intended to aid aircraft in navigating to the vicinity of targets, finding the targets, destroying them, and returning safely to base. Work is under way in such fields as infrared and microwave detection, information display, communication and navigation, and analog and digital computing. Some projects are in the laboratory development stage, some in the flight test stage, some in pilot production.

Good progress is being made in the establishment of facilities and operational patterns that are well tailored to the unique requirements of advanced electronic systems work.

Positions are available for scientists and engineers in these fields of current activity:

Communications Systems
Digital Computers and Control Systems
Airborne Electronic and Control Systems
Electronic Instrumentation and Test Equipment
Guided Missile Research and Development
Automation and Data Processing
Basic Electronic and Aeronautical Research

The Ramo-Wooldridge Corporation

5730 ARBOR VITAE STREET, LOS ANGELES 45, CALIFORNIA

Opportunities

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication

POSITIONS OPEN

MACHINE DESIGNER

Excellent opportunity for creative thinking. Scope to carry thru to completed equipment on automatic mechanical and hydraulic plant machines. Located in the 3/4 million population Denver region, yet only 1 hour to Colorado rockies' hunting, fishing and skiing areas.

Coors Porcelain Co., Golden, Colorado

MECHANICAL ENGINEERS

Minimum of 5 to 10 years' design experience in the field of non-ferrous metallurgy. To join Central Engineering Office now being organized. Large well-established smelting company. Location: New York City. All replies kept confidential. Send complete resume and salary requirements to

F. H. Beardsley
The American Metal Company, Ltd.
61 Broadway, New York 6, N. Y.

ENGINEER, AE, ME

aircraft structural design for

NUCLEAR POWER PLANTS

It is a truism that history is only made by history-makers. No one will dispute the truth of this when it comes to General Electric's pioneering work in applying nuclear energy to aircraft propulsion. Many specialized and highly qualified talents are engaged in this vital area. More are needed.

The position now open offers many opportunities for professional achievement and unique engineering experience. It involves the preliminary design of major aircraft structures, and the coordination of structural design with power plant design requirements. 4 to 6 years' experience in aircraft design and development required.

Openings in Cincinnati, Ohio and Idaho Falls, Idaho

Address replies stating salary requirements to Location You Prefer

W. J. Kelly
P. O. Box 132
Cincinnati, Ohio

L. A. Munther
P. O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

SALES ENGINEER

Recent Engineering graduates, preferably M.E., for approximately one year inside sales training prior to assignment to a territory. Send complete resume to Personnel Department.

EDWARD VALVES, INC.
Subsidiary of Rockwell Manufacturing Company
1200 West 145th Street East Chicago, Indiana

ENGINEER, DESIGN

nuclear aircraft engines mechanical components and systems

From all indications the jet age will be dwarfed by the age of the application of atomic power to aircraft. An opportunity to enter this unusual field in its early stages is now offered the qualified engineer by the Aircraft Nuclear Propulsion Department of our company located in the West and Midwest.

Assignments will involve the designs of mechanical components and systems for use with aircraft nuclear power plants. For this work an ME degree or equivalent is needed, plus 3 to 5 years' experience in design of mechanical devices, structures or systems analysis. Though not essential, work in aircraft power plant field is especially desirable.

Publication of research results in the appropriate classified or open literature is encouraged.

Address replies stating salary requirements to

BOX NO. CA-5670, CARE OF
"MECHANICAL ENGINEERING."

Automotive Engineer

Laboratory Technical Service work on lubricants. Some experience in lubrication field preferred. Major Petroleum Company, New York City.

Address CA-5642, % "Mechanical Engineering."

ENGINEERS

needed to do preliminary analysis, design and development leading to the next generation of high-performance nuclear power plants.

Please write to:

A. E. McLean
Nuclear Power Dept.
Studebaker-Packard Corp.
1580 E. Grand Blvd.
Detroit 32, Michigan

MECHANICAL ENGINEERS
Unlimited opportunity with . . . *Linde*

IN LOW TEMPERATURE ENGINEERING

Projects involve practical design and development engineering in:

- **equipment design**
- **instrumentation and controls**
- **pilot plant design and operation**
- **process engineering**
- **fabricating techniques**
- **heat transfer**
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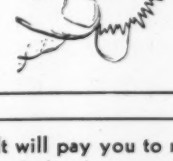
- **thermodynamics**
- **distillation**
- **stress analysis**



These projects are associated with the production and distribution of oxygen, nitrogen and argon as low temperature liquid or gases.

B.S., M.S., or Ph.D. graduates with up to 5 years' experience are invited to investigate.

LINDE AIR PRODUCTS COMPANY
a division of
UNION CARBIDE AND CARBON CORPORATION
Send resumes to: Mr. P. I. Emch
P. O. Box 44, Tonawanda, New York
Refer to ad: ME-L

It will pay you to read the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

engineer

ME AE EE

NUCLEAR AIRCRAFT ENGINE TEST

There is something different about new areas of engineering experience in aircraft nuclear propulsion. Old skills must be adapted to the development of new talents.

At General Electric's ANP Department a career opportunity in the application of atomic energy to aircraft now awaits the qualified engineer.

The position now open is one of importance, involving responsibility for major scale testing program of unique power plant configuration, as well as some design and development work on power plant components. 1 to 3 years' experience in design, development or test of complex, high performance engineer equipment required.

Publication of research results in the appropriate classified or open literature is encouraged.

Openings in Cincinnati, Ohio and Idaho Falls, Idaho

Address replies stating salary requirements to Location You Prefer

W. J. Kelly
P. O. Box 132
Cincinnati, Ohio

L. A. Munther
P. O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

THE APPLIED PHYSICS LABORATORY of the JOHNS HOPKINS UNIVERSITY

offers an exceptional opportunity to qualified men who want to advance themselves professionally in the GUIDED-MISSILE field. The Laboratory has a reputation for the recognition and encouragement of individual responsibility and self-direction.

Our program of

Guided Missile Development

provides such an opportunity for men qualified in:

SERVO MECHANISMS
MISSILE SYSTEMS DEVELOPMENT
MECHANICAL DESIGN AND LAYOUT OF MISSILE COMPONENTS
INTERNAL AERODYNAMICS AND PROPULSION
MACHINE SHOP LIAISON AND PRODUCTION
STRESS ANALYSIS

Please send your resume to:
Professional Staff Appointments

APPLIED PHYSICS LABORATORY
THE JOHNS HOPKINS UNIVERSITY
8607 Georgia Avenue **Silver Spring, Maryland**

ASSISTANT TO MANAGER —FIN-TUBE COIL SALES

A leading manufacturer in the fast growing air conditioning industry has a permanent career opportunity for a graduate engineer who wishes to develop capacity for executive responsibility in engineering, sales and administration. The Trane Company, manufacturers of air conditioning, heating, ventilating and heat transfer equipment, is seeking a young engineer with preferably two or three years' experience with heat transfer equipment and/or fluid flow.

Position offers opportunity of advancement with key department in rapidly expanding concern. Work away from crowded industrial areas and live in a congenial medium-sized community located in the heart of a Midwestern vacationland.

Send detailed resume of education, experience and salary desired to:

Manager of Staff Employment;
THE TRANE COMPANY
La Crosse, Wisconsin

MECHANICAL ENGINEERS:

A Career at Electric Boat... Is An ADVENTURE in Engineering

In the past several years, Electric Boat has been making one headline after another as the nation's first adaptor of nuclear power for propulsion. The Electric Boat-designed and built atom submarines, Nautilus and Seawolf, are already accomplished fact.

Behind the headlines, the work of designing even more advanced atomic submarines goes on. Every day, Electric Boat engineers are coming to grips with problems in nucleonics that pave the way for applications in other fields.

There is room — and opportunity — for more engineers able to cope with these problems. Current openings are for Mechanical Engineers with experience in vibration and shock, machine design, stress analysis, hydraulics, rotating machinery, power plants, or air-conditioning and piping.

These jobs offer more than engineering adventure. There's common-sense practicality involved, too. Electric Boat's backlog of orders and years-ahead plans; its record stable engineering employment; its sponsorship of advanced study at leading universities and within the plant are some of the practical features. New England living on the shores of Long Island Sound is another.

To find out more details about these opportunities, write us details of your background and experience including initial salary requirements. Interviews will be arranged promptly for qualified applicants. Please address **Peter Carpenter.**

ELECTRIC BOAT
DIVISION OF GENERAL DYNAMICS CORPORATION
GROTON, CONNECTICUT

ENGINEERS

for immediate placement

ELECTRICAL ENGINEERS
MECHANICAL ENGINEERS
ELECTRONIC ENGINEERS
COMPUTER ENGINEERS
SOLID-STATE PHYSICISTS

Engineering at NCR:

1. Immediate, permanent positions in Mechanical Engineering, Electrical Engineering and Physics Research Divisions.

2. Engineering project work in Adding Machines, Cash Registers, Accounting Machines, Computers and related Data Processing Equipment in Dayton, Los Angeles, and Ithaca, New York.

3. Opportunities in design, development, production-engineering and packaging of mechanical, electronic, and electromechanical devices.

4. Some experience in development, design, and application of high-speed, light-weight mechanisms of the intermittent-motion type; or, experience in digital devices and components, is desirable, but not essential.

5. Ample training and indoctrination is available to all employees.

As an NCR engineer you, with your family, will enjoy:

1. UNLIMITED OPPORTUNITY in the broad, ever-expanding field of Business Machine Engineering and Research.

2. AN EXCELLENT SALARY, plus exceptional benefits of lifetime value for you and your family.

3. A RECREATIONAL PROGRAM for year-round enjoyment of the entire family, including a new NCR Country Club with 36 holes of golf, and a 166-acre employees' park for outings with swimming, boating, and supervised play for the children.

4. LIVING IN DAYTON . . . considered a clean, attractive, progressive city with outstanding school facilities.

5. YOUR WORK AT NCR with its friendly, family atmosphere, with its employee morale at a very high level, and with people who, like yourself, have decided to build their professional future with NCR.

National*

ACT AT ONCE — Send résumé of your education, experience and geographic preference to:

EMPLOYMENT DEPARTMENT, TECHNICAL PROCUREMENT SECTION 2

THE NATIONAL CASH REGISTER COMPANY
Dayton 9, Ohio

*Trade-Mark—Reg. U. S. Pat. Off.

ENGINEERS
DESIGNERS
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WITH REFINERY & CHEMICAL PLANT EXPERIENCE IN

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APPLY
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SEND RESUME TO

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ENGINEERS—PHYSICISTS

OPPORTUNITIES IN OPERATIONS RESEARCH

THE JOHNS HOPKINS UNIVERSITY

Operations Research Office

offers exceptional opportunities for *ENGINEERS* and *PHYSICISTS* who desire the challenge of military operational problems of unusual scope and diversity to routine design and development work.

Our current research program under a contract with the Department of the Army includes problems in tactics, strategy, weapons systems, intelligence, communications, logistics and military applications of game theory. Studies in these areas are normally carried on by mixed teams of scientists, each of whom is expected to contribute as a specialist to a synthesized solution.

- Selected opportunities for two-year overseas assignments in Germany or Japan.
- Liberal employee benefits and leave privileges.
- Rapid advancement for demonstrated capabilities.
- A competitive salary scale.

Please send your resume to:
Dr. Lincoln Hanson
Research Personnel Officer
7100 Connecticut Avenue
Chevy Chase 15, Maryland

REFRIGERATION AND AIR CONDITIONING ENGINEER

Graduate M.E. with minimum 8 years' broad experience in refrigeration and air conditioning design and project work. To render technical service to operating units and serve as staff consultant on air conditioning and refrigeration problems related to overseas operations located in Saudi Arabia.

Facilities include large central air conditioning plant with chilled water distribution system through entire communities for residential and industrial air conditioning totaling 14,000 tons capacity plus 700 tons of refrigeration for manufacture of ice and storage of commissary supplies.

Must be capable of developing and carrying work assignments to completion. For assignment in New York Engineering Office; occasional field trips required.

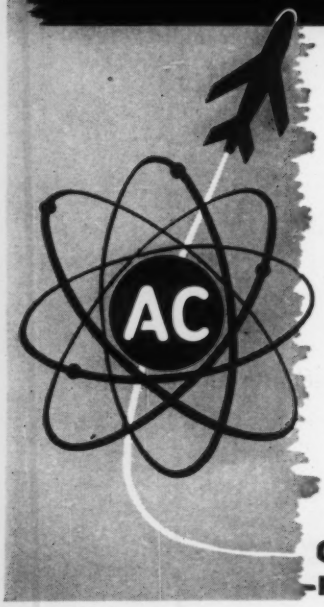
Write outlining work experience and personal history.

Recruiting Supervisor, Box 123

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

ENGINEERS and DESIGNERS NEEDED

for: MISSILE GUIDANCE SYSTEMS · BOMBING NAVIGATIONAL COMPUTER SYSTEMS · NEW CIVIL AVIATION PRODUCTS · JET AND TURBO-PROP ENGINE CONTROLS · AIRBORNE FIRE CONTROLS



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Development Engineering
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Design Engineering
Product Engineering
Product Evaluation
Field Engineering

AND WE ALSO NEED:

DESIGNERS • CHECKERS • LAYOUT MEN

Positions Are Permanent — Excellent Advancement Opportunities

Every inquiry treated confidentially and given immediate attention and personal reply.

WRITE TODAY FOR EMPLOYMENT APPLICATION

Mr. John F. Heffinger
Supervisor of Salaried Personnel

AC SPARK PLUG
THE ELECTRONICS DIVISION

GENERAL MOTORS CORPORATION

Flint 2, Michigan — **Milwaukee 2, Wisconsin**

ENGINEERS

Why let routine work slow your advancement

Working hard but going "No Place..."

...when varied, creative assignments, with high promotion potential, are open at Republic Aviation

It's easy to be so busy that you fail to notice that the work you're doing offers little opportunity to grow in professional knowledge and advance rapidly in individual achievement.

At Republic Aviation, however, the very nature of this highly competitive business insures a continual flow of new and stimulating problems. Every new aircraft design created at Republic must embody a real advance in the "state of the art." Proud as Republic is of the famous planes that bear its name – the F-84 Thunderjet, F-84F Thunderstreak, RF-84F Thunderflash, and the incredible new F-105, RF-105 and F-103 – *the real attention here is focused on radical new concepts under development.*

And your personal life is set in pleasant places, when you work for Republic. You live on Long Island, famous vacation land where you can keep your own boat or board a charter fishing boat any weekend. Play golf, tennis, even polo, and yet downtown New York is at your doorstep.

You enjoy, too, the practical, personal advantages of Republic's comprehensive benefit program including:

REPUBLIC'S NEW 2-FOLD RETIREMENT INCOME PLAN that's the talk of the industry. Part I provides a basic Retirement Income, paid in full by Republic. Part II is optional. It offers additional income on a liberal contributory basis, the company paying over 50%.

REPUBLIC SALARIES ARE HIGH ...among the highest in the country ...and these are permanent jobs.

OTHER OUTSTANDING BENEFITS include an all-expense paid relocation plan for qualified engineers living outside the New York-Long Island area; Life, Accident and Health Insurance; Hospital-Surgical Benefits for the whole family; Educational Aid covering ⅔ of the cost of advanced study.

POSITIONS ARE OPEN AT ALL LEVELS IN:

Aerodynamics • Systems • Propulsion • Operations Research • Dynamics • Stress • Controls • Electronics • Staff Engineering • Electromechanics • Flight Test • Research • Thermodynamics • Flutter & Vibrations • Weights • Weapons Systems Analysis • Servo • Airframe & Mechanical Design • Analog Computers • Antennae • Control Systems • Instrumentation

Please address complete resume, in confidence, outlining details of your technical background to:

REPUBLIC AVIATION

AIRCRAFT
Assistant Chief Engineer
Administration
Mr. R. L. Bortner
Farmingdale, L.I., N.Y.

MISSILES
Administrative Engineer
Mr. R. R. Reissig
Guided Missiles Division
Hicksville, L.I., N.Y.

Fort Wayne, Ind.
"America's Happiest City"

Dear Bill:

Now that Joe is on the team here at Farnsworth, he's asked me to write and give you the same story that got him interested in coming with us.

Actually, Bill, it wasn't a "story." Just a few honest-to-goodness reasons why he and Marge should make the move and let the family really live as well as let Joe grow professionally.

For instance, do you know what "sold" Marge? The fact that in living here you are only 10 minutes from everywhere—schools, churches, stores etc. and Joe goes home for lunch every day instead of week-ends. She also liked the idea of some 300 lakes within 70 miles. (Guess where they're planning to spend the summer!)

As for Joe, he's all hepped up about the work he's doing on such missiles as Bomarc, Talos, Terrier and others. Says the top-notch scientists and engineers he's working with are all big-league and he's on the team.

That's about it, Bill. An engineer with your talents shouldn't be writing around when he can get in on the ground floor here at Farnsworth in research, development or production engineering in missile guidance and control, radar, microwaves, test equipment, countermeasures, transistor applications etc.

So—why not write, right now to Don Dionne, Farnsworth Electronics Co. Fort Wayne, Ind. (A division of International Telephone and Telegraph Corp.)

You, Joe, I and Farnsworth will be mighty glad you did.

Sincerely, Jack

OMAR

Engineers in training... Experienced engineers...

... there's no limit to the opportunities open to you as members of the OMAR team in the fields of:

Rocket and Ramjet Engines
Propellants and Fuels
Testing and Evaluation

Positions are open for the following:

mechanical engineers
combustion engineers
aeronautical engineers
stress analysts
turbine engineers
thermodynamicists
servo engineers
electrical engineers
nuclear engineers
ordnance engineers
instrumentation engineers
test engineers
development engineers
process design engineers
production engineers
physicists
mathematicians
organo-metallic specialists
inorganic chemists
organic chemists
polymer chemists
electrochemists
physical chemists
analytical chemists

On the OMAR team, you're affiliated with pioneers in the field of supersonic propulsion: **Reaction Motors, Inc.**, first in the American rocket industry; **Marquardt Aircraft Company**, the West's largest jet research and development center and first in ramjets; **Olin Mathieson Chemical Corporation**, a leading producer of chemicals, metals, explosives, and high-energy fuels.

You're on a team that unites for the first time both chemical and mechanical experience in research, development, and production of supersonic rockets, ramjets, and liquid and solid propellants.

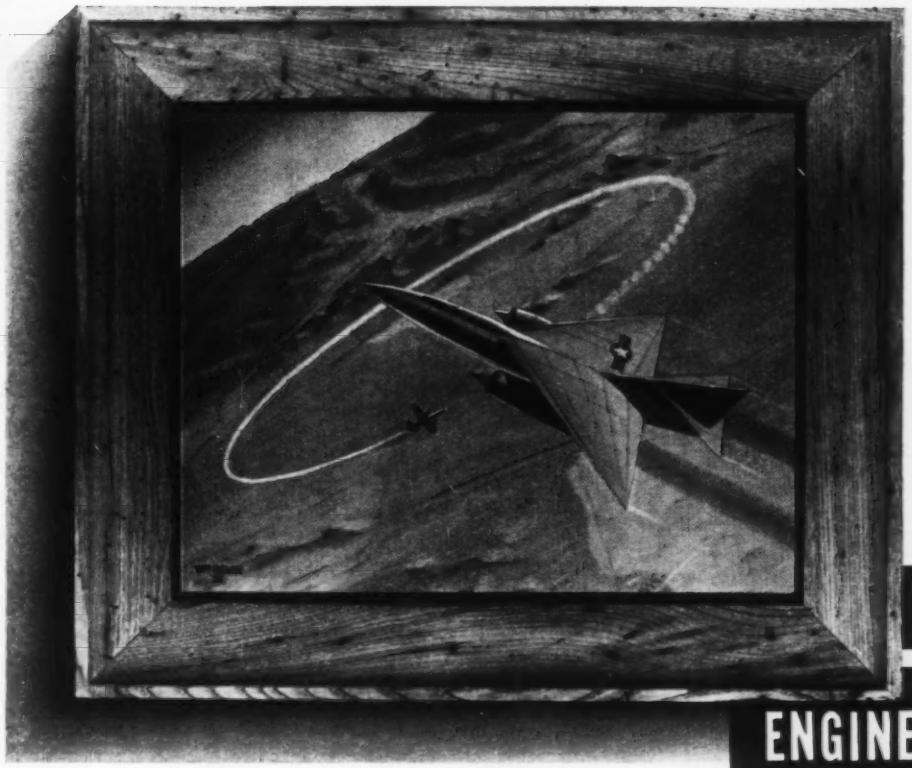
For further information write *OMAR Employment Officer* at the company nearest you.

Olin Mathieson Chemical Corporation
466 Park Avenue, New York 22, N. Y.

Reaction Motors, Inc.
Denville 4, New Jersey

Marquardt Aircraft Company
16557 Saticoy Street
Van Nuys, California

3907



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ENGINEERS
ALL FIELDS

CHEMISTS

PHYSICISTS

MATHEMATICIANS

METALLURGISTS

DRAFTSMEN

ENGINEERING
DRAWING CHECKERS

The art of rocketry

The portraits of tomorrow's propulsion systems are rapidly becoming realities at Aerojet-General. America's foremost manufacturer of rocket powerplants, Aerojet is a major contributor to this nation's most critical rocket and missile programs.

But creation takes talent.

Operations at Aerojet's California plants, near Los Angeles and Sacramento, are expanding rapidly. Unparalleled career opportunities exist for scientific and engineering personnel at all levels of experience.

Please write the Director of Personnel, Aerojet-General Corp., *Box 296, Azusa, Calif.* or *Box 1947, Sacramento, Calif.*

Your resume will receive immediate, confidential attention.

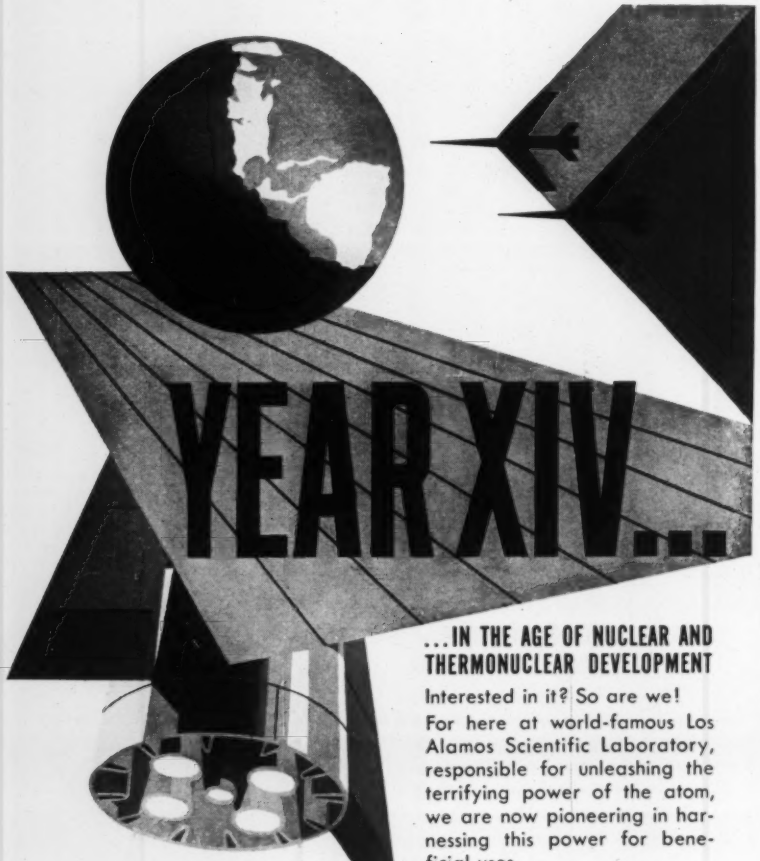
Aerojet-General CORPORATION

A Subsidiary of
The General Tire & Rubber Company

THE GENERAL TIRE

AZUSA, CALIFORNIA
SACRAMENTO, CALIFORNIA

MORE POWER FOR AIR POWER



...IN THE AGE OF NUCLEAR AND THERMONUCLEAR DEVELOPMENT

Interested in it? So are we!

For here at world-famous Los Alamos Scientific Laboratory, responsible for unleashing the terrifying power of the atom, we are now pioneering in harnessing this power for beneficial uses.

There is exciting adventure in the application of nuclear and thermonuclear energy to weapons, power and propulsion.

Supporting these diverse activities here at Los Alamos are many challenging projects in basic physics, chemistry, metallurgy, mathematics and engineering.

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Write us for an illustrated brochure describing the Laboratory, its delightful mountain location and its excellent housing and community facilities. Mail your request to

DIRECTOR OF PERSONNEL
DIVISION 807

LOS ALAMOS SCIENTIFIC LABORATORY IS NOW IN ITS 14TH YEAR OF OPERATION.

los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

MECHANICAL ENGINEERS

Engineering graduates for product design and application. Products are vibration and shock isolation systems on aircraft, electronic, automotive, marine, general industrial equipment. This is a rapidly expanding industry. Excellent long range possibilities for engineers who are interested primarily in design work. Duties also involve extensive liaison between and among field engineering, manufacturing, and research.

BOX 369, ERIE, PENNSYLVANIA

engineers

DESIGN

At General Electric an expanding program has created excellent design opportunities in the areas of Nuclear Reactor facilities, Chemical Separations and Metal Fabrication plants.

In addition to training and experience, imagination and creativeness are prime requisites for fulfilling the growth potential inherent in these permanent positions.

The following unusual positions are now open in the areas of:

- Vibration and stress analysis of structures and complex equipment.
- Design of power plants (steam) and associated equipment including power system stability, heat transfer and turbine performance under varying pressure and flow conditions.
- Manufacturing equipment design and application including pumps, turbines and valves.
- Design control procedures, knowledge of design problems and ability to estimate costs.
- Design metallurgist, ferrous and non-ferrous alloys.

Also **Draftsmen** — Mechanical, piping and electrical.

Write in confidence to General Electric, the organization whose advanced "living-space" concept of human relations is designed to help you happily grow in your chosen field. Please include your experience, age, academic background and professional references. Personal interviews will be arranged with all selected candidates.

Mr. E. P. Galbraith
Technical Personnel Placement

GENERAL ELECTRIC
Richland, Washington

Experience Pays Off at

Bendix

GUIDED MISSILE SECTION

Your M.E. degree can bring you up to $10,000 plus future advancement

INTERMEDIATE MECHANICAL ENGINEERS . . .

Mechanical design and development of military weapons systems (antennas, pedestals, computers, gear trains, precision mechanical devices).

•

These creative positions have more than usual growth potential. The right men can advance to Senior Engineers' responsibilities with a pioneer and world leader in electronics!

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***To arrange confidential interview, send resume to Box CA-5656, care of "Mechanical Engineering."**

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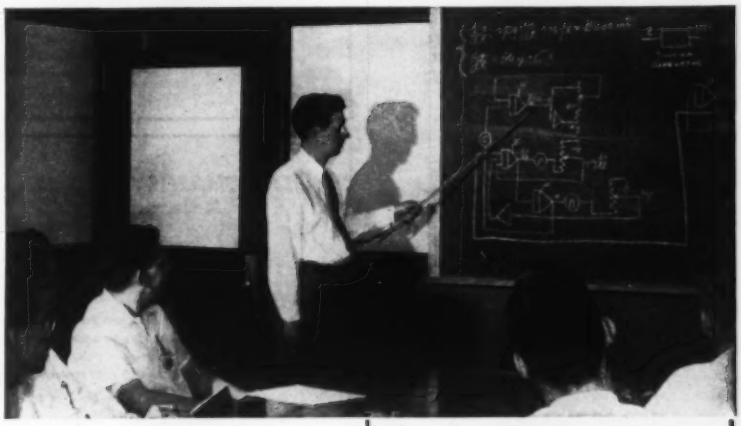

Unusual Job Opportunities for:

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Experienced engineers required for design of precision electronic and electro-mechanical automatic test equipment and instrumentation. Programming, signal generation from low frequency to microwave, analogue and digital data handling, and go-no-go comparators and indicators are involved.

ELECTRONIC GUIDANCE

Senior Electronic Engineers are needed to design and develop guidance systems for a major guided missile project. Backgrounds in microwave, radar and servo systems are required.

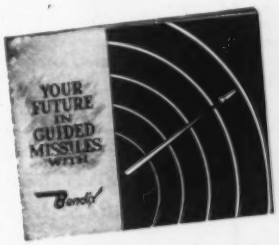
Senior Mechanical Engineers are needed to design and develop electronic packaging for complex missile guidance systems.

SYSTEMS ANALYSIS

Senior Engineers are needed with extensive backgrounds in the over-all dynamic behavior of missiles and weapons systems, as well as airframe systems of a missile, particularly in terms of weapon performance, to work with analogue computers, digital differential analyzers, breadboards, prototypes of missiles and missile equipment, and special mechanical and electronic simulators. Experience with aerodynamics, servo-mechanisms, electronics, heat transfer, stress analysis, shock and vibrations is desirable.

Bendix Guided Missiles offer interesting job opportunities for Senior Engineers, Assistant Engineers, Junior Engineers and Technicians.

A thirty-six page book, "Your Future in Guided Missiles", describing in detail the many phases of our guided missile operation and the job opportunities available to you, will be sent to you on request. Write for your copy today. BENDIX PRODUCTS DIVISION—MISSILES, 409F, Bendix Drive, South Bend, Indiana.



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Openings include design, development, field engineering and sale opportunities.

Opportunities for both experienced and inexperienced mechanical and civil engineering graduates.

Training program available to supplement technical background and experience.

Barber-Greene is one of the outstanding growth companies, which offers life-time careers to outstanding men.

Submit resume outlining background, salary desired, etc., to: Personnel Manager

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Procter & Gamble needs MECHANICAL ENGINEERS

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- Permanent positions in Mechanical Research and Development, Process Equipment Design and Application, Heat and Power Equipment Design and other Engineering Fields.
- Salaries commensurate with education and industrial experience.
- Opportunities to grow with a leading chemical processing company—rated as one of the nation's three best-managed companies by the American Institute of Management.

For application form and further information write

Mr. J. E. Gale
Head of Employment
Engineering Division
The Procter & Gamble Company
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Use a CLASSIFIED ADVERTISEMENT
For QUICK RESULTS

MECHANICAL ENGINEERS

Young mechanical engineers—minimum 2 years' experience for challenging design engineering work in a new line of industrial automation equipment. Work is concerned with the establishment of new performance limits of complex electro-mechanical systems. Program is rapidly expanding—engineers can progress as fast as demonstrated ability.

Send Complete Resume to Box CA-5659, care of "Mechanical Engineering."

MECHANICAL ENGINEERS
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IN LIQUID NITROGEN

Unusual and challenging career openings are offered in liquid nitrogen APPLICATION DEVELOPMENT

- **indefinite preservation and processing of biological materials.**
- **design of liquid nitrogen vacuum insulated containers.**
- **application of extreme pressures and low temperature.**
- **application of liquid nitrogen temperature in the shipment of frozen foods without intransit refrigeration.**

The magnitude and diversity of LINDE products and processes are appealing to Mechanical Engineers who are seeking employment with a dynamic company of proven stability.

Bachelors or Masters are invited to investigate

LINDE AIR PRODUCTS COMPANY
a division of
UNION CARBIDE AND CARBON CORPORATION
Send resume to: Mr. P. I. Emch
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AERODYNAMIC DESIGN

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THERMODYNAMIC DESIGN

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EXPERIMENTAL ANALYSIS

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ADVANCED ENGINE DESIGN

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CONTROLS SYSTEMS DESIGN and ANALYSIS

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A few selected engineering positions with a fine established company located in the Northeast. For further information write to:

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Lockheed diversification in action...

At right: engineers and scientists work on some of the 46 major projects in progress at Lockheed

Operations Research discussion on continental defense

Operations Research openings

Electronics Specialists
Fire Control and Guidance Specialists
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Fatigue test on Super Constellation skin

Structural Engineering openings

Research Specialists
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Stress Analysts
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Why Lockheed offers Engineers better careers

There are three main reasons:

1. More opportunity for promotion
because there are more supervisory positions to be filled with 46 major projects underway, including 13 models of aircraft on assembly lines.

2. More career security
because Lockheed activities cover virtually the entire spectrum of aeronautical endeavor.

3. Life in Southern California
Scenic beauty, unmatched climate, wide recreational opportunities enhance life in the San Fernando Valley.

To Engineers who lack aircraft experience
Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering–at full pay.

Coupon below is for your convenience in requesting application form and more information on how Lockheed's expanding program can advance your career.

Design study on hydraulic requirements of new transport

Design openings

Design positions are open at all levels in controls, electrical, hydraulics, mechanical, power plant and structures fields.

IBM 701 applied to jet transport flutter problem

Math. Analysis openings

Math. Engineers
Math. Specialists
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Flight Test Engineering openings

Flight Test Engineers
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Instrumentation Engineers
Electrical Research Engineers

Aerodynamic meeting on high-speed fighter

Aerodynamics openings

Aerodynamics Engineers
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Dynamics Engineers
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"OPPORTUNITIES" 145-161

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TWO CAREER POSITIONS

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MAJOR RESPONSIBILITY

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Materials Handling

The Engineering Service Division of du Pont's Engineering Department has two long-range career positions immediately available for graduate engineers with three to ten years' experience with bulk or package handling systems and equipment. The successful applicants will be expected to have engineering knowledge of belt conveyors, bucket elevators, screw conveyors, storage bins, chutes, hoppers, and feeders. Familiarity with pneumatic conveyors or mobile handling equipment is desirable.

Duties include providing consultation on existing equipment, selection of new equipment, and the development and execution of major materials handling engineering programs.

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CLEVELAND INTERVIEWS

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For appointment, please call

Mr. J. C. Costello, Jr.

PRospect 1-6850

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Or you may send complete resume, including details of education and experience, to:

Mr. J. C. Costello, Jr.

Engineering Department

DU PONT

Better Things for Better Living ...through Chemistry

E. I. du Pont de Nemours & Co., Inc.

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MECHANICAL ENGINEER

To act as technical assistant to maintenance superintendent in Chemical Plant. Candidates should be graduate engineers not over 35 years of age. Background of at least 5 years of experience with refinery or chemical plant equipment desired. Give full and specific details of education, experience and desired salary. Pleasant environment and good benefits including pension plan. Inquiries will be considered promptly and held confidential.

Address CA-5679, % "Mechanical Engineering."

PIPING DESIGN & LAYOUT ENGINEER
HEATING & VENTILATING ENGINEER

Due to our expansion program, the abovementioned permanent positions are available in a large pulp and paper manufacturing plant in the Upper Midwest. The individuals desired should be graduate engineers with a minimum of five to ten years' experience who are well versed in their respective fields. Our employees know of these openings. Your confidential reply should include personal, educational and work history together with salary thinking.

Address CA-5540, % "Mechanical Engineering."

SENIOR MECHANICAL ENGINEERING CONSULTANT

To act as chief engineering consultant to all departments in research laboratory of large business and industrial equipment manufacturing company. Must be able to formulate fundamental investigative program in machine design and mechanisms development. Will advise and assist project engineers in achievement of engineering objectives. May, if desired, carry out research and development programs.

This is a top technical job in a company with a large engineering organization and only men with noteworthy technical achievements will be considered.

Send Complete Resume to Box CA-5658, care of "Mechanical Engineering."

PERFORMANCE and INSTALLATION ENGINEER

There are two positions open in the preliminary design activity of an aircraft power plant manufacturer located in New England. This activity deals with performance requirements and installation analysis of proposed engines. It guides Design and Development Engineers in planning characteristics and configuration of new engines and integrating them with advanced type aircraft.

Requirements are a Bachelor or advanced degree in mechanical or aeronautical engineering, plus 3 to 5 years' engineering experience in airframe or aerodynamics, and a working knowledge of air inlet, exhaust nozzles, ducting, and cooling problems.

The salary is commensurate with ability and experience, and is coupled with many other company benefits. These positions offer an opportunity to be a forerunner in power plant development and to grow professionally in a well-recognized engineering organization.

For further information prior to personal interview, please write to:

Box CA-5654, care of "Mechanical Engineering."

Wanted: 2 SENIOR

Mechanical Engineers

FOR WORK IN

Nuclear Power Group

INTERESTING, ADVANCED WORK
EXCELLENT LIVING CONDITIONS

These are exceptional opportunities for men with an M.S. or Ph.D. in Mechanical Engineering. Some experience or training in reactor work is desirable but not essential.

OPENING "A"

Responsibility for engineering design and analysis; work primarily theoretical but requires good practical background.

OPENING "B"

Responsibility for heat transfer work and design; work largely theoretical but requires sound practical approach.

Excellent salaries; stimulating atmosphere; progressive policies; wonderful New England living; fine schools. Please write today to William Robba, Nuclear Power Group, Research Division.

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Raytheon Manufacturing Co.

Waltham 54, Massachusetts

Excellence in Electronics

Important for engineers and scientists...

MTP

RCA'S MISSILE TEST PROJECT

Instrumentation at MTP provides stimulating assignments for Electronic and Opto-Mechanical Engineers, Physicists, and Mathematicians. Significant contributions to the design and development of a 5000 mile Missile Testing Range can be made by those who join the RCA-MTP Team *NOW*. Proficiency is desired in Instrumentation Planning, Radar, Telemetry, Timing, Communications, or Optics. Relocation expenses paid.

Arrange your interview by sending resume to:

Mr. W. T. A. Baxter
Personnel Mgr., Dept. N-6E
RCA Service Co., Inc.
P. O. Box 1226, Melbourne, Fla.

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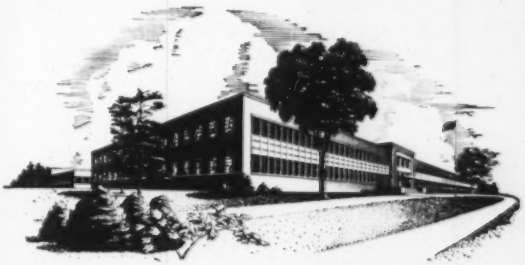
RADIO CORPORATION of AMERICA

SENIOR POSITIONS

now open at Combustion Engineering's



NEW NUCLEAR ENGINEERING AND DEVELOPMENT CENTER

At Combustion's new Nuclear Center in Windsor, Connecticut, there are immediate openings for qualified

Aeronautical Engineers	**Mechanical Engineers**
Chemical Engineers	**Metallurgists**
Chemists	**Naval Architects**
Design Engineers	**Nuclear Engineers**
Electrical Engineers	**Physicists**
Mathematicians	**Statisticians**

Structures Engineers

You'll be in on the ground floor of a fascinating and growing field – with a company that's one of the world's oldest and largest makers of power generation equipment. And in the *nuclear* power field, too, Combustion is a leader.

Combustion is the third major contractor selected by AEC to design and build a submarine nuclear propulsion system – and will be the first company in the country to complete such a contract using its own facilities.

At Windsor (only 8 miles from Hartford) you'll find CAREERS, not *jobs* – in a delightful area providing every facility for pleasant living. And you'll find, also, unexcelled employee benefits – tuition reimbursement plan for advanced study . . . liberal retirement benefits . . . hospitalization and major medical expense insurance . . . life insurance.

If you're a citizen and are interested in a career in Nuclear Power – send a complete resume, in confidence, to:

COMBUSTION ENGINEERING, INC.

Reactor Development Division, Room 1021-F
111 Eighth Avenue, New York, N. Y.
Phone: MUrray Hill 9-4600, Ext. 720

8-917

NUCLEAR POWER ENGINEER

To initiate and direct the design, testing and customer liaison associated with valve and piping developments for atomic power and other nuclear activities. Advancement prospects excellent with company highly regarded for products and research work in power and process fields. Salary open, replies confidential. Write or contact Personnel Director.

Edward Valves, Inc., Sub. of Rockwell Mfg. Co.
East Chicago, Indiana

MACHINE DESIGNERS AND ENGINEERS

Machine designers and design engineers wanted for permanent positions. Design experience desired in either paper converting machinery, box manufacturing equipment or packaging equipment. Excellent working conditions and opportunity for advancement.

Address CA-5647, % "Mechanical Engineering."

METHODS INDUSTRIAL ENGINEER

To apply engineering techniques towards improving paper work flow and merchandise movement problems of large metropolitan department store. Prefer 2 or 3 years in large industrial or commercial organization.

Excellent opportunity to apply creative engineering.

Liberal employee benefits including hospitalization, surgical and medical, discount privilege, retirement. Starting salary $6,000 to $7,000.

Resume should include educational background, work history, age, military status and salary desired.

Address CA-5682, % "Mechanical Engineering."

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Steam Power Engineer for large New England utility. Attractive permanent position open for mechanical engineering graduate with broad background of responsible design experience in modern steam power generation who has served as Principal Project Engineer for two or more public utility steam power plant developments of 75,000 KW or greater capacity. Age range 40–50.

Address CA-5681, % "Mechanical Engineering."

VISCOSE RAYON

DESIGN AND PROJECT ENGINEER — Graduate Mechanical Engineer, 3–5 years' experience in Rayon or Chemical Industry, to be in charge of Design and Drafting Office in the Engineering Department or smaller rayon plant. Scope of work covers machinery — piping — and building — design, equipment layouts, engineering calculations and estimates.

Please send full resume and salary requirements to:

Hartford Rayon Company
Division of Bigelow-Sanford Carpet Co.
Rocky Hill, Connecticut

SEE CHEMSTRAND'S AD ON PAGE 49 OF THIS MAGAZINE

Positions available for

ENGINEERS

(Chemical, Mechanical, Metallurgical, Textile, Industrial, Instrument and Civil) and

CHEMISTS

(Organic, Physical, Analytical —Instrumental and Wet Method, Textile Chemists.)

Write to Technical Personnel Department

THE
CHEMSTRAND
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ENGINEER

atomic era caliber

POWER PLANT

If you are a mechanical engineer with broad specialization in design and development of steam power stations, you can help move the coming nuclear energy revolution out of its infancy and into lusty manhood.

We are not looking for a comfortable-rut thinker. We want someone whose inner growth is just as important to him as it is to us. He is the engineer whose working knowledge of power system stability, heat transfer and turbine performance under varying pressure and flow conditions can be put to creative use in a new field. A background in electrical system reliability, characteristics and problems is also desirable.

Write in confidence to General Electric, the organization whose unique Personnel Department and Benefit programs are designed to help you grow in the career you are looking for. Personal interviews will be arranged with all selected candidates.

Send resume to:

Mr. E. P. Galbraith
Technical Personnel Placement

GENERAL ELECTRIC

Richland, Washington

DIRECTOR OF ENGINEERING

We are seeking a Director of Engineering. The blueprint of his specifications includes: *Education as an engineer. Age 35–45. At least 10 years of progress through the engineering departments of a medium-sized, or larger, packaged-processed-product (chemical or food rather than "hard" goods) manufacturer employing the most modern production techniques. Present or very recent position—chief engineer or his principal assistant with a salary of at least $12,000 a year with a company in the food, drug or allied product field. For at least the past 5 years, responsibility for all new construction and equipment, as well as other engineering functions. A record of real accomplishment, rather than a potential for accomplishment.*

The salary potential is a minimum of $20,000; headquarters, Mid-Atlantic seaboard; environment, city, with a minimum of travel; potential employer, company with most modern plant in its industry.

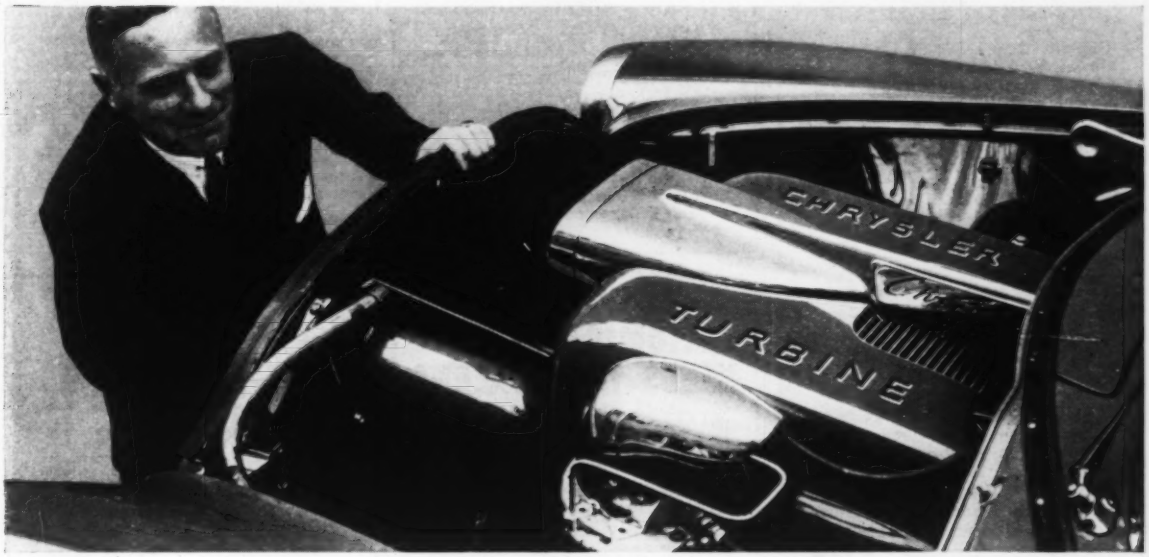
If you are interested and can meet the qualifications stated, reply stating your present position, your education, your experience in brief resume form, full personal statistics and a brief description of that achievement you most esteem that contributed to your progress. Your reply will be kept most confidential, and any interview resulting is to be kept in strict confidence by you as well.

Address CA-5666, care of "Mechanical Engineering".

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

Engineers—there's excitement a-plenty at Chrysler Corporation!

Here you'll find the excitement of working ahead of the field, of being able to make full use of your creative imagination.



Mr. G. J. Huebner, Executive Engineer-Research, with the regenerative Chrysler Gas Turbine—the first gas turbine to successfully power an American production model passenger car.

Chrysler Corporation is a company with a long record of "firsts" in the automotive field. This record didn't just happen! It came about through the efforts of our engineers, working in a climate where the "impossible" is simply something to overcome.

Here you see one of those "firsts"—Chrysler Corporation's regenerative gas turbine automobile. This raging twister, weighing nearly 200 pounds less than a piston engine of comparable power, easily fits a Plymouth's engine compartment. In this gas turbine two major problems long encountered in this field—high exhaust heat and high fuel consumption—have been overcome, and its performance is now comparable with the reciprocating engine.

We're looking for engineers who will help us meet the engineering challenges of tomorrow—*today*. Especially interesting career opportunities are here in gas turbine, reciprocating engine and nuclear power, advanced chassis design, fuel injection systems, automatic transmissions, brakes and suspension systems. Also test and development work both here and at the famed Chrysler Proving Ground—world's largest.

These are permanent, non-military positions in *civilian* programs, with security for the future. You'll be working with the finest engineers in the business and there's no limit to the experience that can come to you. And there's no limit on how far or fast you can advance with Chrysler Corporation. It all depends on you—and what you bring to the job.

Can you afford *not* to have all the facts about these wonderful opportunities? And about your opportunities to earn a Master's Degree at the famed Chrysler Institute of Engineering Graduate School? Get all the details and study them at your leisure. Write Mr. L. C. Bettega of Chrysler Engineering at P.O. Box 1118, Detroit 31, Michigan.

Engineering Division

CHRYSLER CORPORATION

P. O. Box 1118, Detroit 31, Michigan

See Chrysler Corporation's great TV Shows, "Shower of Stars" and "Climax!" Thursdays on CBS

"OPPORTUNITIES" Section This Month 145-161

DESIGN ENGINEER

Excellent opportunity for a really creative engineer willing to grow into administrative responsibilities. Inventiveness and the ability to be truly objective are the keys to a successful career with a progressive organization having the largest Research and Engineering facilities in the steel valve industry.

Edward Valves, Inc., Sub. of Rockwell Mfg. Co.
East Chicago, Indiana

MECHANICAL RESEARCH ENGINEER

Graduate engineer with experience desired for research on mechanisms in motion picture, lithographic and photographic industries. Send half-page resume to

Director of Research
TECHNICOLOR MOTION PICTURE CORPORATION
2800 W. Olive Avenue
Burbank, California

INDEPENDENCE FOR MECHANICAL ENGINEER

Are you capable of designing, laying out and stress analyzing large castings and weldments? Then you will enjoy the independent responsibility assured by a heavy machinery manufacturer. Hydraulic experience and mechanical engineering degree desirable, but not necessary. Best working conditions. Top salary to top talent. New York State.

Mechanical draftsmen with 3 years' minimum experience in heavy machinery. Can expect same consideration.

Address CA-5673, % "Mechanical Engineering."

AREA ENGINEERS

Several graduate engineers with minimum 5 years' experience supervising maintenance engineering functions in oil refining or producing facilities, power plants, heavy industrial installations, manufacturing plants or related operations. To establish technical supervision, procedures, maintenance operations, and schedule routine and special work for major oil producing and refining operation with all supporting facilities; i.e., housing, feeding, recreation, etc.

Salary commensurate with background and experience. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 66

ARABIAN AMERICAN OIL COMPANY

505 PARK AVENUE
NEW YORK 22, N. Y.

VISCOSE RAYON

CHIEF ENGINEER—Graduate Mechanical Engineer with at least 10 years' experience in Rayon Industry, preferably in staple, to take over-all charge of Engineering Department of smaller rayon plant. Scope of position covers maintenance, power, design and construction. Administrative ability required.

Please send full resume and salary requirements to:

Hartford Rayon Company
Division of Bigelow-Sanford Carpet Co.
Rocky Hill, Connecticut

ATOMIC ENERGY NEEDS YOUR TALENT

ALCO PRODUCTS, INC., wants additional competent Mechanical Engineers for nuclear power development. The potentialities of this growing field are limitless. YOU can help it grow! YOU can grow with it!

Typical positions available are:

MECHANICAL DESIGN ENGINEER

Experience Required: Minimum of 10 years including design and test of complex mechanisms and mechanical structures.

ASSISTANT PROJECT ENGINEER

Experience Required: 2 to 5 years' design or test of mechanical components.

JUNIOR ENGINEER

Experience Required: None. Also needed are several Mechanical Designers and Draftsmen.

IF INTERESTED please forward detailed resume and salary requirements to:

G. Y. Taylor, Manager
Employee Services Dept.

ALCO PRODUCTS, INC.
Schenectady 5, N. Y.

All replies kept confidential.

MECHANICAL ENGINEER (SALES)

Graduate M E or equivalent for Sales position with expanding recognized power press industry.

Outstanding opportunity for energetic young engineer 25 to 35 years of age who is interested in an engineering sales career.

Sales territory available after interesting training program is completed.

Applications will be treated in strict confidence and should contain a complete resume of your personal and work histories.

Address CA-5651, % "Mechanical Engineering."

SENIOR MECHANICAL DEVELOPMENT ENGINEER

With technical education and ten to twenty years of experience or more in design and development of heavy machinery or similar experience, for research and development work both as to design and from industry study points of view. Permanent position with opportunities to grow are involved in expanded program of well-established heavy machinery, rolling mill and hydraulic press builders. Location Pittsburgh. Write complete details of experience, pertinent personal information and enclose photograph in first letter. Salary $10,000 per year or more, depending on experience.
Also opening available for a man with above general qualifications, but having less experience. Salary in proportion.

Address CA-5529, % "Mechanical Engineering."

DESIGN ENGINEERS—Mechanical experience automatic machinery desirable also plant layout board or pulp plants. Salary open. Reply in first letter giving details, training, experience, references and present salary range. Location South. Address CA-5641, care of "Mechanical Engineering."

DESIGN ENGINEER—Aluminum Product Development. To assist Chief Design Engineer in offering technical assistance and design service all branches of industry. Position requires exceptional design ingenuity, imagination, flexibility and offers stimulating combination of diversified design activities and personal contact with leaders in industry. Please send resume to: Director of Engineering Services, Reynolds Metals Company, 2500 S. Third St., Louisville, Kentucky.

MECHANICAL ENGINEER—Recent M.E. graduate desired for employment as project engineer in long established valve manufacturing firm. Permanent Position. Excellent opportunity for advancement. Salary commensurate with ability. Located in progressive North Central Penna. community. Experience in Pressure Vessels and piping desirable, but not necessary. Submit qualifications. Address CA-5646, care of "Mechanical Engineering."

ENGINEER, CHEMICAL OR MECHANICAL—Internationally known midwest firm requires a mature responsible individual with several years' experience in the selection, layout, and installation of chemical and process equipment. Applicant, in addition to possessing the necessary technical qualifications, should have the resourcefulness and aggressiveness to follow each assigned project through to completion. Work involves some equipment maintenance as well as design and layout of new installations. Please furnish detailed resume of experience and background. Address CA-5649, care of "Mechanical Engineering."

FOUNDRY OPENINGS—Mechanical Engineers—One man to do plant engineering and assist Foundry Superintendent in production. One man to sell high quality castings. Both men should be capable of development to position of greater responsibility in medium-sized, progressive, Midwestern foundry. Some foundry experience preferred, but not necessary. Address CA-5653, care of "Mechanical Engineering."

ENGINEERING DRAFTSMEN—Mechanical and Electrical wanted by large stable corporation. Good future for desirable applicants. Give references, education, experience and salary expected in first letter. Location South—City of 30,000. Excellent living conditions. Address CA-5662, care of "Mechanical Engineering."

POSITIONS OPEN

ELECTRICAL ENGINEER with degree, for large paper mill operation. To take charge of High Pressure Power Plant, Electrical and Pipefitting Department. Work involves operation, maintenance, installation and related engineering. Heavy boiler experience desirable. Salary open. Age about 35. Location—Pennsylvania. Address CA-5531, care of "Mechanical Engineering."

INSTRUCTOR of Industrial Engineering—Bachelor's degree in Industrial Engineering or I.E. option of Mechanical Engineering plus four years' industrial engineering experience. ASSISTANT PROFESSOR of Industrial Engineering—Master's degree in Industrial Engineering plus four years' industrial experience and two years' teaching experience. Salaries commensurate with education and experience. Both positions offer graduate study, research and summer employment opportunities. Department of Industrial Engineering, Syracuse University, Syracuse 10, New York.

TEACHING POSITIONS in civil, mechanical engineering, beginning September, 1956. Salary and rank open. Apply Administrative Dean, Fresno State College, Fresno 4, California.

MECHANICAL ENGINEER—on railroad located in central region. Steady employment with opportunities for advancement with progressive organization. In reply state age, experience, and salary expected. Address CA-5600, care of "Mechanical Engineering."

ADVERTISING MAN WANTED FOR TECHNICAL PRODUCTS—Previous advertising experience not necessary but helpful. Must have at least two or three years of college with courses in engineering and technical subjects and like to write. If you have the qualifications we have an opportunity open for you. Man selected will be trained in all phases of industrial advertising. In your letter of application state age, education, positions held, and give statement of why you want a career in advertising. Location: well-known Connecticut company. Address CA-5630, care of "Mechanical Engineering."

WANTED—Detail and Design Draftsmen with minimum of one year experience in power boiler detail drafting. Please give age, schooling, experience and minimum salary requirements. Springfield Boiler Co., Springfield, Illinois.

APPLIANCE DESIGN ENGINEER—For well-established eastern manufacturer of motor driven appliances and power tools. Must have broad experience in all phases of product design and development and in engineering for production. Should be familiar with processes and equipment used in mass production of electric tools and small appliances. Permanent position; excellent opportunity; good working conditions. Submit experience and salary requirements. All replies confidential. Address CA-5667, care of "Mechanical Engineering."

ELECTRICAL ENGINEER—to head up electrical division in design engineering department for plant layout work including automatic control for mechanization project. Experience in board plant or pulp mill helpful. Give education, experience and salary desired in first letter. Location South—city of 30,000. Excellent living conditions. Address CA-5675, care of "Mechanical Engineering."

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MECHANICAL ENGINEERING
April, 1956 CARD INDEX Vol. 78, No. 4

Manufacturing Synthetic Lumber in Germany, A. Elmendorf, W. Klauditz and A. Lühning 310
Ceramics as Basic Engineering Materials, E. J. Smoke and J. H. Koenig 315
Cermets for High-Temperature Service, J. T. Norton 319
Vacuum-Melting Nickel-Base Alloys on a Production Scale, F. N. Darmara and J. S. Huntington 323
Nodular Iron in Switchgear, F. E. Florschutz 327
Steel's Role in Nuclear Engineering, C. L. Huston, Jr. 329
Selection and Application of Spring Materials, H. C. R. Carlson 331
ASME Rubber and Plastics Division 335
Plastics as Mechanical-Engineering Materials, J. A. Bjorksten 337
Engineering Developments of Rubber—September, 1954, August, 1955, Lillian Cook and L. E. Straka 341
Editorial 309
Briefing the Record 351
European Survey 366
ASME Technical Digest 369
Comments on Papers 378
Reviews of Books 379
ASME Boiler and Pressure Vessel Code 381
ASME News 384

For Reference

A 20-PAGE LIST OF ASME PUBLICATIONS

is included in the

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Copies of the List are obtainable from
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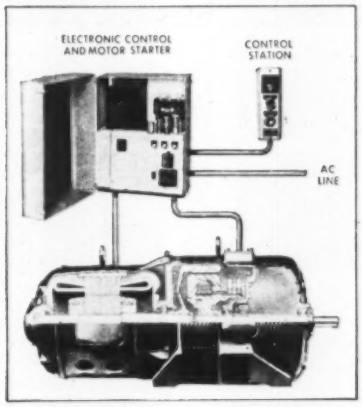

The small illustration shows the minimum of typical components necessary to obtain adjustable speed with Dynamatic eddy-current equipment. Speed regulation requirements on the order of 1/10 of 1 per cent of drive top speed are easily and economically accomplished with suitable control modifications. With low powered reliable electronic components, requirements to suit almost all drive problems are easily met without appreciably increasing the cost or size of the control components.

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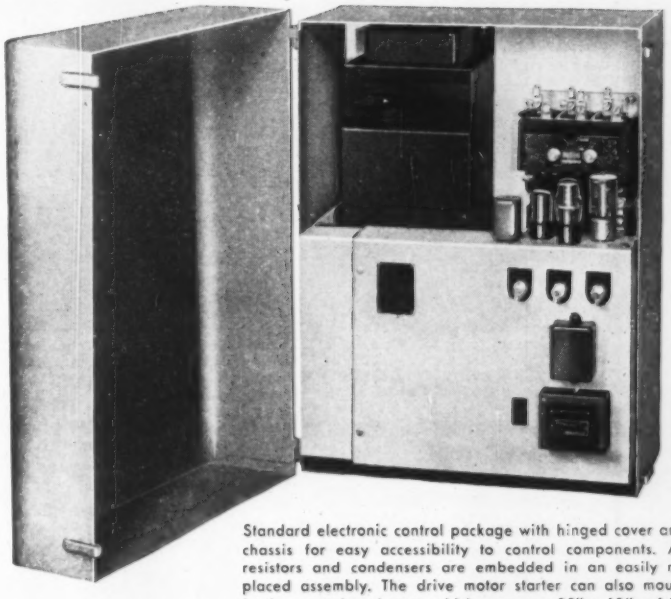

Standard electronic control package with hinged cover and chassis for easy accessibility to control components. All resistors and condensers are embedded in an easily replaced assembly. The drive motor starter can also mount in the control enclosure, which measures 25" x 19" x 14".

Direct current excitation applied to the Dynamatic Drive coil modulates the strength of the magnetic fields and consequently, the amount of torque developed at any rate of slip between the rotating input and output members. So that the drive may satisfy load and speed demands, this direct current must be varied automatically.

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To obtain desired performance, a means of varying the amount of current to the drive coil must be provided. The thyratron tube provides this function in that the grid of the tube, influenced by an AC rider wave imposed upon the DC grid voltage, permits a smooth change in drive coil voltage from zero up to the available maximum.

A permanent magnet alternator, driven by the output shaft of the Dynamatic Drive, generates a voltage in direct proportion to speed. This voltage directed to the electronic control is utilized to maintain pre-set speed. With a reduction in load, speed tends to increase, but the generator signals the control so that the drive coil current decreases, slowing down the unit. Conversely, should the load increase, the drive tends to slow down so that the generator signal to the electronic control automatically increases the current, permitting the drive to return to the pre-set speed.

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Index to Advertisers

AC Spark Plug Electronic Div., General Motors Corp. 148
Acme Chain Corp. 53
Acushnet Process Co. 80
Aerojet-General Corp. Sub. General Tire & Rubber Co. 151
*Alco Products (Inc.) 160
*Aldrich Pump Co. 32
All American Tool & Mfg. Co. 80
Aluminum Co. of America 19
*American Blower Corp. Div. American-Standard 136
*American Brass Co. 31
American District Steam Co. Adsco Industries (Inc.) 142
*American Pulverizer Co. 69
ASME Publications 66,110
Mechanical Catalog 55
Annin Co. 143
Arabian American Oil Co. 148
Atlas Chain & Mfg. Co. 24
Avco Mfg. Corp. 122

*Babcock & Wilcox Co. 2nd Cover
Barco Manufacturing Co. 4
Bendix Prod. Div.—Missiles 153
*Blaw-Knox Co. Grating Dept. 72
Bigelow-Liptak Corp. 26
Boeing Airplane Co. 128
Bruning, Charles, Co. 92, 107
Bundy Tubing Co. 126
Byers, A. M., Co. 123
*Byron-Jackson Div., Borg-Warner Corp. 93

Carborundum Co. 37
*Cash, A. W., Co. 125
Cash, A. W., Valve Mfg. Co. 75
Chace, W. M., Co. 63
*Chain Belt Co. 17, 18
Chapman Valve Mfg. Co. 106
Char-Lynn Co. 79
Chemstrand Corp. 49
Chicago Rawhide Mfg. Co. 95
Chrysler Corp. Engrg. Div. 159
Cincinnati Gear Co. 65
Clarage Fan Co. 100
Clearprint Paper Co. 5
*Columbia-Geneva Steel Div. 6, 7, 102, 116, 117
*Combustion Engineering (Inc.) 157, 166
Cone-Drive Gears Div. Michigan Tool Co. 43
Convair Div. General Dynamics Corp. 77, 132
Crane Packing Co. 47
Curtiss-Wright Corp. 130

DeZurik Shower Co. 140
*Diamond Power Specialty Corp. 133
Douglas Aircraft Co. 96
Dresser Industries (Inc.) 114, 115
Dudek & Bock Spring Mfg. Co. 79
DuMont, Allen B., Labs. (Inc.) 12
DuPont, de Nemours, E. I. & Co. 156

Eagle Pencil Co. 16
Eaton Mfg. Co. Dynamatic Div. 163
Edward Valves (Inc.) Sub. of Rockwell Mfg. Co. 111
*Elastic Stop Nut Corp. of America 59
Electric Boat Div. General Dynamics Corp. 146

*Falk Corp. 83
Farnsworth Electronics Co. 150
*Foxboro Co. 14, 15
Fulton Sylphon Div. Robertshaw-Fulton Controls Co. 39

Garrett Corp. AiResearch Mfg. Div. 139
*Gear Specialties (Inc.) 2
General Electric Co. 127, 145, 146, 152, 158
*Golden-Anderson Valve Spec. Co. 67
*Grinnell Co. 13
Grumman Aircraft Engrg. Corp. 54

Hagan Corp. 94
Hamilton Mfg. Co. 90
Hamilton Standard Div. United Aircraft Corp. 138
Hathaway Instrument Sub. Hamilton Watch Co. 69
Horspool & Romine Mfg. Co. 68
*Hyatt Bearings Div. General Motors Corp. 10, 11

*Illinois Gear & Machine Co. 105
International Nickel Co. 34

Jenkins Bros. 40
Johns Hopkins University 146, 148
Johnson, Carlyle, Machine Co. 87

Kennametal (Inc.) 29

Lake Shore (Inc.) Lake Shore Engrg. Div. 141
LimiTorque Corp. 55
Lincoln Electric Co. 56
Linde Air Products Co. Div. Union Carbide & Carbon 145, 154
Linear (Inc.) 109
*Link-Belt Co. 97
Lockheed Aircraft Corp. 155
Loewy-Hydropress Div. Baldwin-Lima-Hamilton 99
Los Alamos Scientific Laboratory 152
Lunkenheimer Co. 3rd Cover

Mammoth Furnace Co. 139
Manzel Div. of Houdaille-Hershey Corp. 57
Martin Co. 58, 81
Melpar (Inc.) Sub. of Westinghouse Air Brake Co. 62
*Mercoid Corp. 54
Meriam Instrument Co. 50
Miniature Precision Bearing (Inc.) 66

National Cash Register Co. 147
National Power Show 98
New Departure, Div. General Motors Corp. 1
New York Air Brake Co. 131
Niagara Blower Co. 140
North American Aviation (Inc.) 70, 82, 85, 86, 118, 120, 137
*Northern Blower Co. 44
Northrop Aircraft (Inc.) 124
Nugent, Wm. W. & Co. 60

*Oilgear Co. 129
Olin Mathieson Chemical Corp. 150

*Pangborn Corp. 52
Parker White-Metal Co. 112
Parsons, Ralph M., Co. 148
Peerless Electric Co. 73
Pittsburgh Lectrodryer Co. 104
Philadelphia Gear Works 55, 88
*Posey Iron Works 142
Powell, William, Co. 108
*Powers Regulator Co. 27
Pratt & Whitney Div., United Aircraft Corp. 46, 61
Procter & Gamble Co. 154

Racine Hydraulics & Machinery (Inc.) 25
Radio Corp. of America 157
Ramo-Wooldridge Corp. 144
Raybestos-Manhattan (Inc.) Packing Div. 165
Raytheon Mfg. Co. 157
Read Standard Corp. 74
Reliance Gauge Column Co. 42
Republic Aviation Corp. 149
Republic Mfg. Co. 138
Revere Copper & Brass (Inc.) 101
Ric-Wil (Inc.) 30
Robertshaw-Fulton Controls Co. Fulton Sylphon Div. 39
Rockford Clutch Div. Borg-Warner Corp. 71
*Rockwell Mfg. Co. Nordstrom Valve Div. 33
Ross Heat Exchanger Div. American-Standard 89
Ruthman Machinery Co. 78

Sanborn Co. 21
Sandia Corp. 48
*Southwest Products Co. 137
*Stewart, F. W., Corp. Sub. of S. S. White 140
Stewart-Warner Corp. Alemite Div. 113
Streeter-Amet Co. 138
*Struthers Wells Corp. Div. Titusville Iron Works Co. 45
Sturtevant, P. A., Co. 66
*Synchro-Start Products (Inc.) 141
*Syntron Co. 137

*Tennessee Coal & Iron Div. 6, 7, 102, 116, 117
*Terry Steam Turbine Co. 84
Thomas Flexible Coupling Co. 51
*Timken Roller Bearing Co. 4th Cover
*Titusville Iron Works Co. Div. of Struthers Wells Corp. 45
Trane Co. 146

*Union Iron Works 20
Union Spring & Mfg. Co. 68
United States Graphite Co. Div. of Wickes Corp. 22, 23, 134, 135
*United States Steel Corp. 6, 7, 102, 116, 117
*United States Steel Export Co. 6, 7, 102, 116, 117

Van Der Horst Corp. 76
Vickers (Inc.) Div. Sperry Rand Corp. 103
Virginia Gear & Machine Corp. 88
*Vogt, Henry, Machine Co. 91

Waldes Kohinoor (Inc.) 119
Walworth Co. 3
Westinghouse Bettis Plant 64
*Wickes Boiler Co. Div. of Wickes Corp. 8, 9
Wiegand, Edwin L., Co. 51
Williams Gauge Co. 50
*Wolverine Tube Div. Calumet & Hecla (Inc.) 28

*Yarnall-Waring Co. 35

*Zallea Brothers 121

* The asterisk indicates that firm has product catalog in the 1956 Mechanical Catalog.

Your attention is directed to

Keep Informed 41–80
Consulting Service 162
Opportunities 145–161

Advertisers appearing in previous 1956 issues

Ackerman Engravers
Aero Research Instrument Co.
*Air Preheater Corp.
Ajax Flexible Coupling Co.
*Allegheny Ludlum Steel Corp.
Allen-Bradley Co.
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*Cochrane Corp.
*Consolidated Chimney Co.
Copperweld Steel Co.
Coxhead, Ralph C., Corp.
Crane Co.
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Cunningham, M. E., Co.

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*Kewanee Boiler Div.
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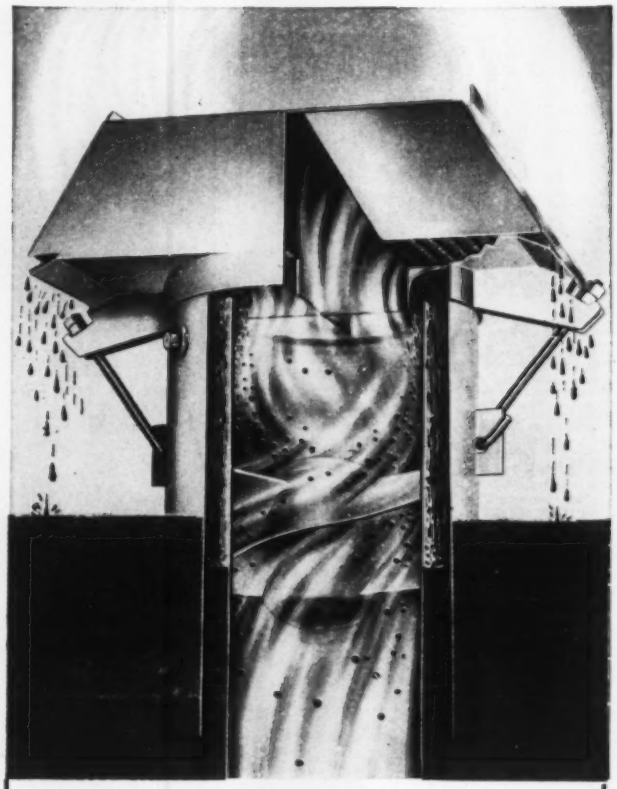

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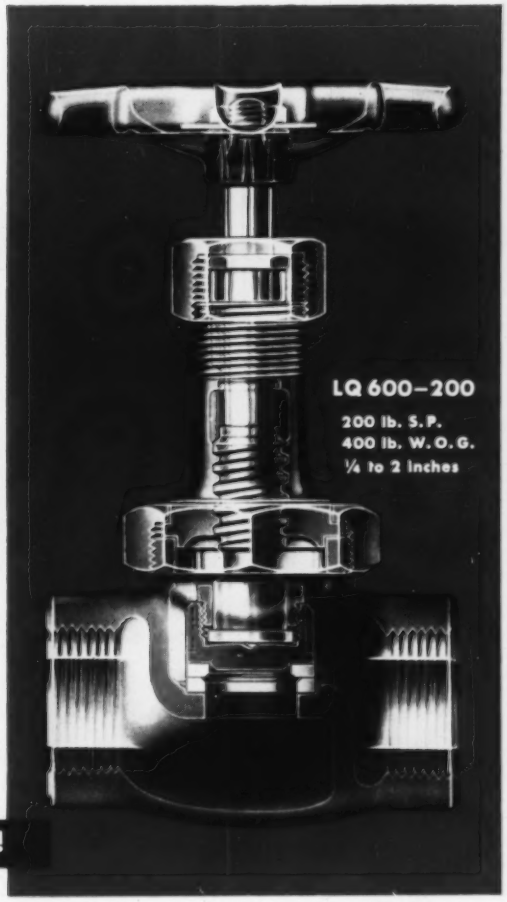

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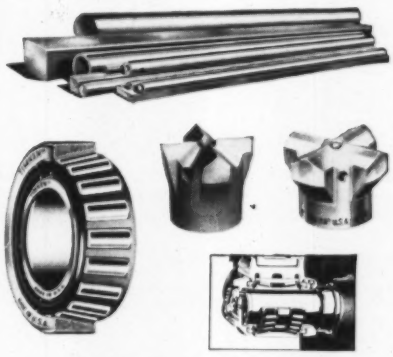

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